

# **ENERGY SURVEY FOR THE UNITED STATES DISCIPLINARY BARRACKS (USDB)**

AT

FORT LEAVENWORTH, KANSAS

## **FIELD DATA**

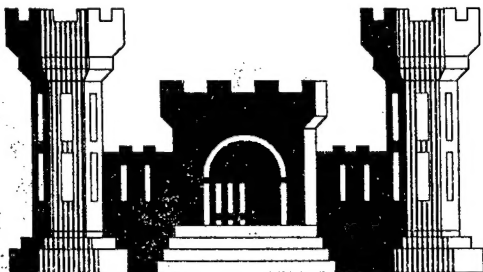
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### **ENERGY ENGINEERING ANALYSIS PROGRAM**

CONTRACT NUMBER DACA41-89-C-D197

JUNE 25, 1990



**KANSAS CITY DISTRICT  
CORPS OF ENGINEERS**

**EXECUTIVE SUMMARY**

**C  
R  
B**




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Marie Wakefield,  
Librarian Engineering

**INTRODUCTION****A. General Description**

The United States Disciplinary Barracks (USDB) is located within the confines of Fort Leavenworth near Leavenworth, Kansas. Fort Leavenworth encompasses approximately 6000 acres of land in which approximately 2000 acres were developed for military use. The USDB is located to the northeast corner of the base.

**B. Purpose of Report**

The purpose of this report is to observe any present energy usage by the USDB and consider opportunities to conserve energy. The report details evaluation of various Energy Conservation Opportunities (ECO) to determine their feasibility.

The report also includes programming or implementation documentation for those ECO's considered feasible. Any ECO having a Savings to Investment Ratio (SIR) greater than one is considered feasible. If the ECO had a SIR greater than one and a simple payback less than 10 years it was considered for Energy Conservation Investment Program (ECIP) funding.

**C. Observations**

During our field trips to the USDB, we noted many observations relating equipment in disrepair. In general, little of the heating, ventilating, and air conditioning equipment appeared to have been maintained. Because of a lack of preventative maintenance throughout the USDB, a considerable amount of energy is being consumed with no appreciable contribution to the operation of the facility. The equipment controls are in need of maintenance the worst. A large portion of the control systems for the equipment were disconnected due to the lack of funding for repair. A preventative maintenance plan is currently under consideration at the USDB, but because of lack funding and proper personnel, the program could be in jeopardy.

DTIC QUALITY INSPECTED 2

Some of the feasible ECO's described in this report will replace equipment that might not have been replaced if the original equipment had had preventative maintenance.

Some of the equipment was not in service because of a pending repair, thus no energy was used. The calculations completed with an estimate of what the equipment might use if it were operating.

#### **D. Computer Programs**

A number of different computer programs were used in the development of this report. To calculate the energy usage of each of the buildings, we used a program entitled "Trace Ultra" provided by the Trane Company. This program uses an hour by hour energy calculation routine as presented in Chapter 25 of the American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE) Handbook of Fundamentals. Simplified energy calculations were completed using an electronic spreadsheet. The "Life Cycle Cost in Design" (LCCID) Economic Analysis Computer Program, developed by the Government thru the University of Illinois, was used to calculate the life cycle cost estimates.



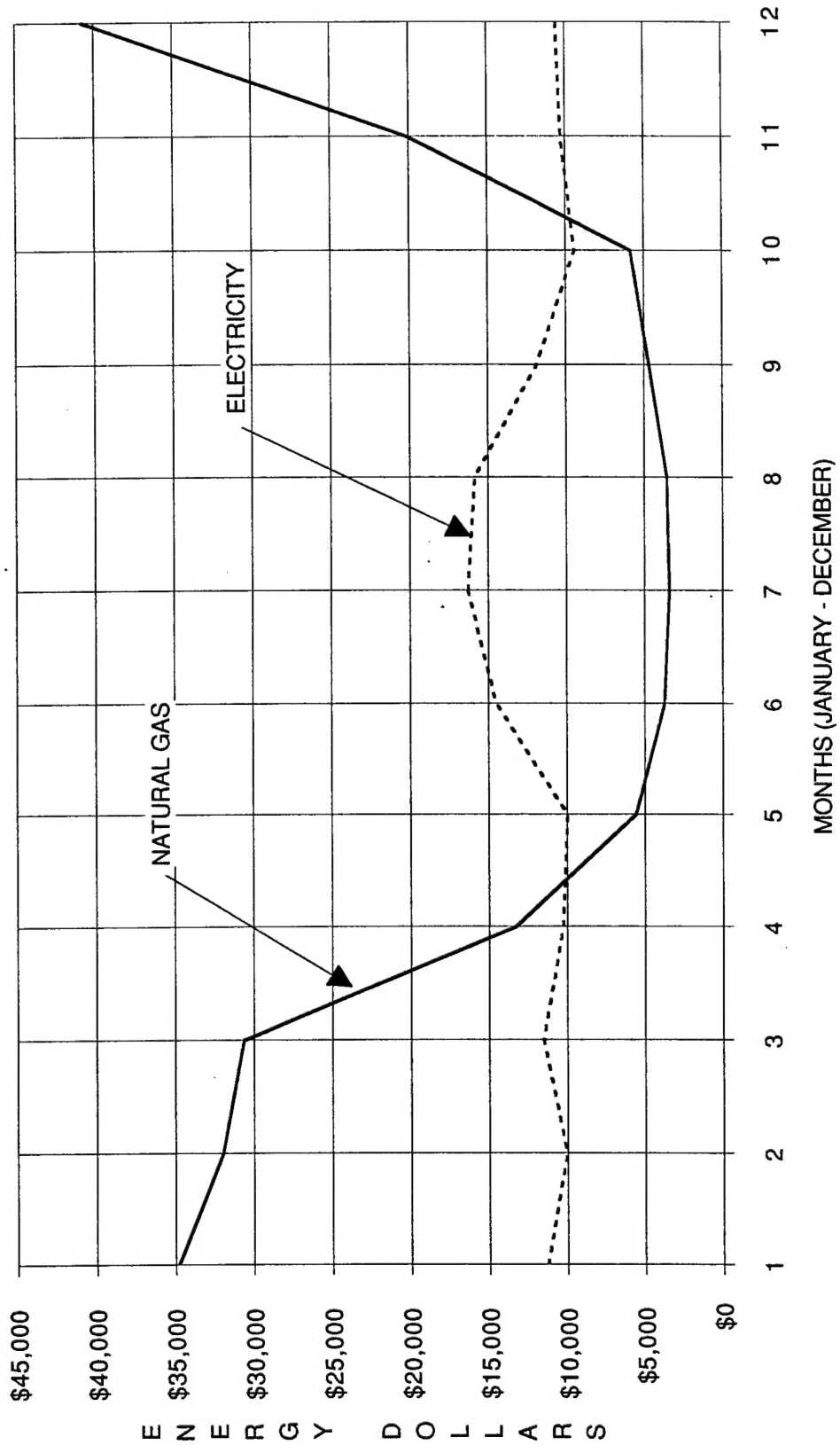
## **PRESENT ENERGY CONSUMPTION**

### **General Description**

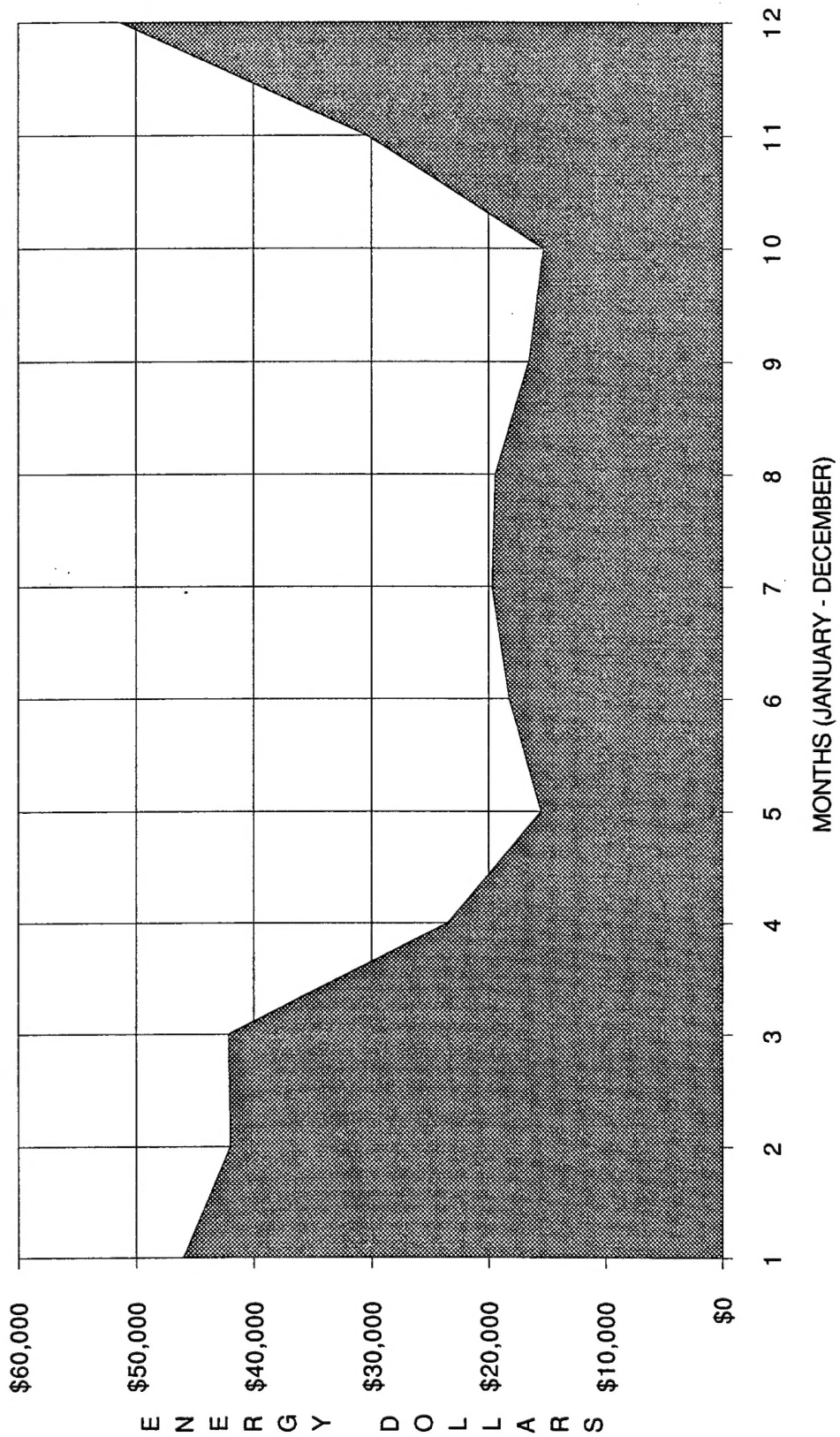
At the present time the energy usage associated with the United States Disciplinary Barracks (USDB) is in the form of three utilities. The first is electricity. The USDB uses electricity for all lighting, fan motors, and pump motors. The electricity used by the USDB is purchased from the electric utility for the area, Kansas Power and Light (KPL). The second utility used by the USDB is natural gas. Natural gas is used to fire the boilers in the boiler plant in the north section of the USDB. The boilers produce steam to be used in converters to make domestic hot water and in air handling unit coils for heating the spaces. The natural gas used to fire the boilers is purchased from the local gas utility Kansas Power and Light (KPL). Water is the third utility used in the USDB. The water is consumed in several different ways but in larger quantities by the inmate restrooms and showers. Water is purchased from a water plant owned and operated by Fort Leavenworth located on the grounds of the fort.

The following pages display the energy consumed per building studied and an overall energy consumption. Several buildings located in the USDB were not included in the scope of work to be studied. Therefore the overall energy usage would not be a total for the entire USDB. The energy usage included on the following pages is for the electrical and natural gas utilities. These energy usage amounts were calculated for each of the buildings. The USDB does not have metering available to check the amount of energy actually used.

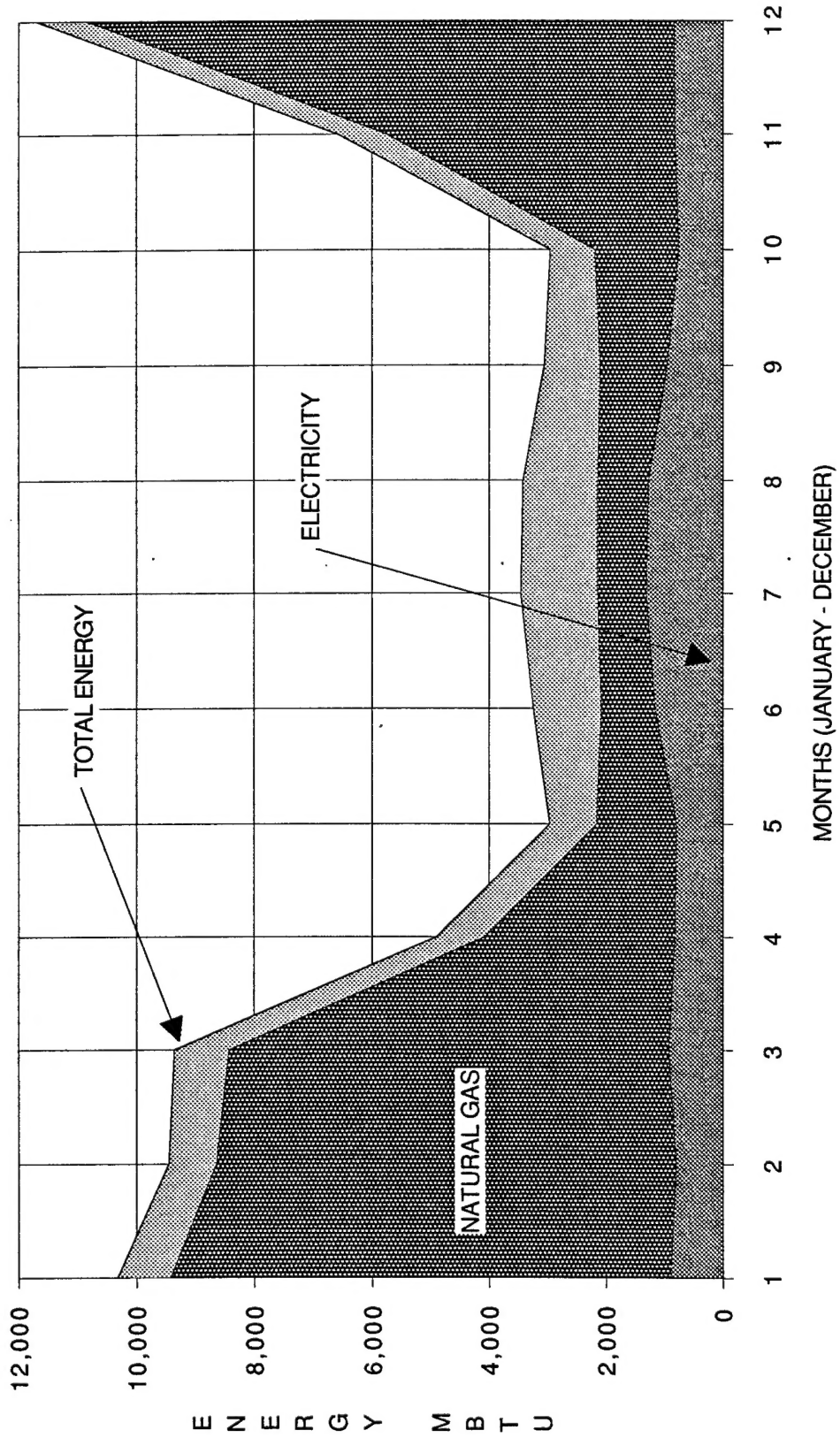
# NATURAL GAS COST VS. ELECTRICITY COST



# MONTHLY ENERGY COST FOR USDB FACILITY



# MONTHLY ENERGY USAGE FOR USDB FACILITY



## SUMMARY OF ECO'S

### ARCHITECTURAL

#### ECO A1. Reduce Infiltration

Presently, most of the windows and doors for the buildings located in the USDB have large cracks that allow outside air to infiltrate the buildings. Reduction of the air quantities entering the buildings is not difficult and can be accomplished by weatherstripping and caulking. This work can be performed by the maintenance staff at a low cost.

Because computer modeling of this ECO showed poor economic return, we do not recommend it.

#### ECO A2. Window Replacement

This ECO studied the installation of double glazed windows anywhere single glazed windows exist. The replacement windows are hermetically sealed with an air gap between the two plates of glass. Infiltration into the building is usually decreased because the new windows seal the opening better.

The double glazed windows have much better insulating quality than single glazed windows. However, they are expensive to install and will not provide an adequate payback unless new windows are already required. Therefore, we are not recommending this ECO.

#### ECO A3. Attic Insulation

The addition of insulation to the building attics will reduce the overall heat transfer coefficient of their roofs, translating into a decreased amount of heat transferred to or from the interior spaces of the building.

Installation of 10" fiberglass batt insulation in the attics of the existing buildings is not difficult and can be accomplished by the maintenance staff.

This ECO is recommended for buildings 464, 472, and 475.

#### ECO A4. Dock Door Replacement

This opportunity for heating energy conservation relates to a dock door located in building 470. The existing overhead dock door is in poor condition. The energy savings associated with a new door is derived from a reduction in heat transferred from interior spaces and from

decreased infiltration. The USDB carpentry shop would be required to replace the door to make the project feasible.

#### ECO A5. Vestibules

Vestibules reduce energy consumption by limiting the amount of outside air infiltration into buildings through frequently used doors. The implementation of this project will change the appearance of the exterior of building #463. At the present time, no vestibules exist at the entrance or exit of this building.

Especially during the heating season, the heating equipment runs non-stop to satisfy the space conditions. Most of the time, however, the temperature conditions are not met. If the heating and cooling equipment were adequately sized, a return on the investment due to energy savings would be more likely. However, we do not recommend this ECO based on existing conditions.

#### ECO A6. Solar Window Shading

This energy conservation opportunity was studied for all the buildings having cooling. The reduction in solar gain through an unshaded window is beneficial during the cooling season but not during the heating season.

An increase in heating energy may be required to offset the reduced solar heat gain in the winter. Some of the buildings that are entirely air conditioned and that contain large amounts of glass will save energy dollars by the addition of solar film, while other buildings experience increased energy consumption.

The only building showing a payback on this ECO is building 450.

#### ECO A7. Exterior Wall Insulation

The addition of insulation to exterior building walls was studied and found to be difficult to implement in a facility of this nature. The materials necessary must have reasonable resistance to damage due to the nature of the occupants of the buildings. Because of the expense this type of construction, implementation of this ECO is not feasible.

#### A9. Architectural Repairs

This section is not an ECO, but a study of architectural repairs recommended for USDB buildings. Many of the items considered do not have a direct relationship to an energy savings but are listed as recommended service items for the USDB. The repairs are small in nature, and some may reduce energy consumption in the buildings, but this is difficult to calculate.

## MECHANICAL

### ECO M1. Schedule Air Handling Equipment

This ECO studied energy savings associated with scheduling of HVAC equipment for shutoff or setback during periods when heating or cooling are required. This can be accomplished by adding some of the equipment to the existing Energy Management System (EMS) network. This project is recommended for building 465.

### ECO M2. Dry-Bulb Economizer Controls

This ECO studies the service or addition of economizer controls and dampers to air handling units utilizing outside air at the present time. The economizer functions by using outside air for cooling when the outdoor temperature is low enough to provide cooling for the building (Approximately 60°F). The air handling units studied now have or had economizer controls and dampers, but do not function properly at this time. This ECO is not recommended at this time.

### ECO M3. Service Steam Piping and Traps

This ECO studied the service or replacement of faulty steam traps. Energy savings are shown by a reduction in steam use if the failed traps are repaired so that they do not pass steam into the condensate piping. Steam traps are devices that consistently fail, and are designed to be easily replaceable and repairable. These devices need to be regularly checked and serviced or replaced, if necessary, for maximum system efficiency.

Failure to maintain the steam traps properly results in wasted energy and prevents air from being vented from the piping system, which corrodes the piping, causing premature pipe failure. This ECO is recommended for the USDB.

### ECO M5.

This ECO studied the addition of heat recovery systems for the exhausted air from the cell barracks in the Castle Building. The locations of the heat recovery systems are ideal because the exhaust air is directly adjacent to the intake air to be preheated. This ECO is recommended for buildings 475C, 475D, 475G, and 475F.

### ECO M6. Insulate Ductwork

This ECO investigates the addition of exterior insulation to supply air ductwork. The heat transferred through the walls of the ductwork is a function of the heat transfer coefficient of the ductwork material. Adding



insulation to the ductwork improves the heat transfer resistance and therefore limits the amount of energy lost.

Uninsulated ductwork routed through unconditioned areas wastes energy. The only ductwork at the USDB facility that is in this category is located in the exterior walls of the Castle building, where installation of insulation is not feasible.

#### ECO M10. Central Plant Cooling

This ECO studies the replacement of all the packaged air cooling equipment with a central plant chiller producing chilled water for cooling coils located in the air handlers at the individual buildings. In almost all of the cases where a space is being cooled, a packaged direct expansion type of cooling system is utilized.

The cost per BTUH of cooling by a direct expansion type of machine is greater than the cost per BTUH of chilled water system cooling. Replacing the existing direct expansion cooling equipment with a centrifugal chiller plant with cooling towers for heat rejection can conserve energy. However, the cost of removing the existing cooling equipment and installing new chilled water equipment and installing the chilled water distribution piping in the existing tunnels makes this project not feasible.

#### ECO M11. Castle Air System Repair

This ECO studied the energy savings associated with properly heating and ventilating the cell barracks of the Castle Building. At the present time, the air within the cell barracks is stratified. Air stratification occurs when warm air rises to the upper level of a building and cooler air settles to the lower level. This causes overheating of the upper level in order to provide adequate heating in the lower level.

Repairing the air system in the Castle Building allows the warmer air at the upper level to be recirculated down to the lower level, thereby reducing energy consumption in the building. This ECO is recommended in buildings 475C, 475D, 475F, and 475G.

#### ECO M12. Reduce Steam Distribution Pressure

This energy conservation opportunity deals with reducing the steam pressure needed for the USDB facility. The laundry requires 120 psi steam, while steam used for space heating can be supplied at 80 psi pressure. Lower pressure steam costs less to generate.

We recommend that the laundry facility be served by a single 120 psi boiler when the existing boilers are replaced (within the next two years).



The space heating requirements of the facility can then be served by two boilers operating at 80 psi.

#### ECO M14. Service Condensate Return System

This ECO analyzes the energy savings associated with the repair and insulation of the condensate return system serving the Castle Building. The existing piping has holes drilled in the top of the piping in various locations. Repairing these holes will result in less energy loss from the condensate. This repairing and insulating of the condensate piping will result in higher temperature condensate returning to the boiler plant, thus requiring less boiler energy to produce steam. This ECO is recommended.

#### ECO M15. Boiler Plant Modifications

This ECO studies the boiler plant and any modifications that could save energy. The energy lost during a blowdown of a boiler can be recovered and used to preheat the boiler feedwater. Installing a boiler stack economizer is another possible method of heat recovery off of the boilers. Preheating the combustion air to the boilers will save boiler energy. Oxygen trim control will help improve the operating efficiency of the boilers.

Seven items of energy conservation for the Boiler Plant were investigated and five items were eliminated. The two remaining items, boiler stack economizer and boiler oxygen trim control, offer energy savings.

We recommend that oxygen trim controls be purchased when the existing boilers are replaced within the next two years. Incorporation of any improvements to the existing boilers would be injudicious, because the payback could not be realized before the existing boilers are replaced.

#### ECO M24. Convert from Steam to Hot Water

This ECO studied the conversion of the existing high pressure steam generation and distribution system to a high temperature hot water type system. The cost per BTUH for using steam is greater than the cost per BTUH for using hot water. The required increase in system efficiency to justify the construction cost is not obtainable, making this ECO not feasible.

#### ECO M25. Convert from Steam to Cogeneration

Due to the large capital investment and the impact of the operating costs, a very detailed analysis must be performed before funding is considered

for cogeneration. The scope of this ECO is to determine if the investment in a complete cogeneration feasibility study is justified.

Cogeneration is possible when a large heating energy and cooling energy requirement occur simultaneously and for a sufficient time period. The feasibility of cogeneration depends on the facility electrical and thermal loads and how they interrelate. This is especially true when the cost of both electricity and natural gas are moderate, as they are at the USDB.

The most efficient system, offering the best return on investment, would be a cogeneration system tied into a central cooling plant utilizing absorption chillers, which could use the waste heat for cooling purposes.

#### ECO M26. Reduce Hot Water Temperature

This ECO studied the energy savings associated with a reduction of the domestic hot water temperature used for restrooms and showers. An energy savings can be realized by lower heat losses from the system.

This ECO can be implemented at no cost by directing the maintenance staff to change the setpoint for all water heaters within the USDB from 180°F to 140°F. The reduction in water temperature will reduce the capacity of the domestic hot water system. This ECO is recommended, however, its impact will be reduced by implementation of ECO-M30.

#### ECO M29. Decentralize Hot Water System

This ECO studied the break-up of the domestic hot water system. At the present time several buildings are served from a hot water tank located in one building. By decentralizing the hot water system, the heat loss from a considerable amount of branch piping can be eliminated. Due to the cost of construction required to implement this ECO, the project is not feasible.

#### ECO M30. Domestic Water Pipe Insulation

This energy conservation opportunity evaluates the installation of pipe insulation for the domestic hot water piping. Energy is saved by reducing the amount of heat loss from the piping to the surrounding environment. This ECO offers attractive energy savings in the Castle building and in the pipe tunnels and is recommended for the USDB.

#### ECO M31. Heat Recovery for Laundry

This ECO studied the addition of heat recovery units for the laundry washwater, clothes dryers, and the steam irons to conserve energy usage. The best opportunity for implementation of this ECO would be when the laundry facility reaches a permanent location. By this means,

the heat recovery systems can be incorporated into the design more readily than for installation in an existing facility. Washwater and dryer heat recovery are recommended.

#### ECO M39. Water Heating Heat Pumps

This ECO studied the replacement of the existing heating and cooling equipment with a heat pump system to condition the interior spaces. In general, heat pumps have a greater efficiency than the existing types of heating and cooling equipment employed in the USDB buildings.

None of the buildings studied for heat pump installations were feasible due to the high construction costs. The heat pump system also has a higher maintenance cost than the existing heating and cooling equipment.

## **ELECTRICAL**

### **ECO E1. Lighting Levels**

This ECO investigates the reduction in lighting levels in areas where the existing lighting was considered to be more than necessary. Installation of motion sensors can provide a good payback in conference rooms and chapels where the lighting loads are high and the space is unoccupied 30% of the time.

### **ECO E2. Energy Efficient Lighting Systems**

This ECO studies the replacement of existing lighting systems with more efficient lighting systems of the same light level. The replacement of lights would reduce the electrical consumption of the lighting system.

We recommend replacing the existing fluorescent lamps and ballasts with high efficiency lamps and ballasts during routine lighting maintenance by the USDB staff.

We also recommend replacement of the existing incandescent light fixtures in building #475A stairwells with high efficiency fluorescent fixtures.

### **ECO E3. Energy Efficient Motors**

This ECO studied the replacement of existing motors that operate fans and pumps with high efficiency motors that have a higher KWh per horsepower rating. The increase in motor efficiency will decrease the amount of electrical energy used by the motors.

We recommend that the motors listed in Volume One of this report with calculated SIR values greater than 1.0 be replaced with high efficiency motors. We also recommend that all new motors installed at the USDB be high efficiency motors.

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S INVESTIGATED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL<br>PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|

### REDUCE INFILTRATION

|    |  |     |         |          |          |         |      |
|----|--|-----|---------|----------|----------|---------|------|
| A1 | BUILDING #463<br>SOUTH GATE / VISITORS   | 12  | \$49    | \$10,617 | \$11,254 | 217.43  | 0.07 |
| A1 | BUILDING #464<br>OUTSIDE BARBER SHOP     | 9   | \$42    | \$5,549  | \$5,882  | 123.73  | 0.12 |
| A1 | BUILDING #465<br>INSIDE BARBER SHOP      | 256 | \$1,061 | \$61,405 | \$65,089 | 58.08   | 0.28 |
| A1 | BUILDING #466<br>CARPENTRY SHOP          | 1   | \$8     | \$18,112 | \$19,199 | 4544.00 | 0.00 |
| A1 | BUILDING #472<br>PRINT SHOP / COLLEGE    | 62  | \$265   | \$25,015 | \$26,516 | 96.18   | 0.17 |
| A1 | BUILDING #473<br>CLASSIFICATION          | 12  | \$54    | \$12,250 | \$12,985 | 215.67  | 0.07 |
| A1 | BUILDING #475<br>ROTUNDA                 | 15  | \$59    | \$7,865  | \$8,337  | 129.39  | 0.12 |
| A1 | BUILDING #475A<br>INVESTIGATION          | 93  | \$399   | \$9,504  | \$10,074 | 23.61   | 0.66 |
| A1 | BUILDING #475B<br>DINING / LIBRARY       | 16  | \$65    | \$9,793  | \$10,381 | 151.20  | 0.11 |
| A1 | BUILDING #475C<br>HSG. UNIT / RECEPTION  | 42  | \$171   | \$31,812 | \$33,721 | 186.69  | 0.09 |
| A1 | BUILDING #475D<br>HSG. UNIT / 4-BASE     | 48  | \$195   | \$37,748 | \$40,013 | 193.27  | 0.08 |
| A1 | BUILDING #475E<br>DINING / LAUNDRY / GYM | 53  | \$146   | \$42,102 | \$44,628 | 283.56  | 0.07 |
| A1 | BUILDING #475F<br>HSG. UNIT              | 89  | \$365   | \$37,990 | \$40,269 | 105.02  | 0.15 |
| A1 | BUILDING #475G<br>HSG. UNIT              | 41  | \$169   | \$32,708 | \$34,670 | 196.54  | 0.08 |
| A1 | BUILDING #475H<br>MSA / D&A BOARD / TDS  | 20  | \$85    | \$7,563  | \$8,017  | 92.50   | 0.17 |

### WINDOW REPLACEMENT

|    |   |     |       |           |           |        |      |
|----|---|-----|-------|-----------|-----------|--------|------|
| A2 | BUILDING #450<br>MENTAL HYGIENE         | 104 | \$455 | \$34,048  | \$36,091  | 74.60  | 0.21 |
| A2 | BUILDING #465<br>INSIDE BARBER SHOP     | 217 | \$892 | \$369,241 | \$391,395 | 414.93 | 0.04 |
| A2 | BUILDING #475<br>ROTUNDA                | 78  | \$317 | \$104,902 | \$111,196 | 331.03 | 0.05 |
| A2 | BUILDING #475C<br>HSG. UNIT / RECEPTION | 161 | \$658 | \$208,538 | \$221,050 | 318.52 | 0.05 |
| A2 | BUILDING #475D<br>HSG. UNIT / 4-BASE    | 237 | \$967 | \$244,911 | \$259,606 | 254.16 | 0.06 |
| A2 | BUILDING #475F<br>HSG. UNIT             | 186 | \$761 | \$244,911 | \$259,606 | 323.81 | 0.05 |
| A2 | BUILDING #475G<br>HSG. UNIT / FEM HSG   | 164 | \$671 | \$208,538 | \$221,050 | 312.81 | 0.05 |

### ATTIC INSULATION

|    |  |     |       |          |          |        |      |
|----|--|-----|-------|----------|----------|--------|------|
| A3 | BUILDING #464<br>OUTSIDE BARBER SHOP     | 106 | \$583 | \$3,215  | \$3,408  | 5.54   | 2.57 |
| A3 | BUILDING #472<br>PRINT SHOP / COLLEGE    | 34  | \$194 | \$2,438  | \$2,584  | 11.72  | 1.19 |
| A3 | BUILDING #475<br>ROTUNDA                 | 142 | \$578 | \$4,592  | \$4,868  | 7.96   | 2.03 |
| A3 | BUILDING #475E<br>DINING / LAUNDRY / GYM | 40  | \$169 | \$30,487 | \$32,316 | 187.69 | 0.09 |

### DOCK DOOR REPLACEMENT

|    |                                       |    |      |       |       |       |      |
|----|---------------------------------------|----|------|-------|-------|-------|------|
| A4 | BUILDING #470<br>POPE HALL / VOC SHOP | 17 | \$69 | \$870 | \$922 | 12.65 | 1.28 |
|----|---------------------------------------|----|------|-------|-------|-------|------|

\* TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S INVESTIGATED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL<br>PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|

### VESTIBULES

|    |  |    |      |          |          |         |      |
|----|--|----|------|----------|----------|---------|------|
| A5 | BUILDING #463<br>SOUTH GATE / VISITORS | 12 | \$49 | \$88,238 | \$93,532 | 1807.08 | 0.01 |
|----|--|----|------|----------|----------|---------|------|

### SOLAR WINDOW SHADING

|    |   |     |        |         |         |         |       |
|----|---|-----|--------|---------|---------|---------|-------|
| A6 | BUILDING #450<br>MENTAL HYGIENE         | 80  | \$498  | \$2,001 | \$2,121 | 7.84    | 1.66  |
| A6 | BUILDING #463<br>SOUTH GATE / VISITORS  | -17 | (\$53) | \$2,056 | \$2,179 | -73.68  | -0.37 |
| A6 | BUILDING #464<br>OUTSIDE BARBER SHOP    | -11 | (\$26) | \$1,782 | \$1,889 | -596.00 | -0.20 |
| A6 | BUILDING #472<br>PRINT SHOP / COLLEGE   | 18  | \$74   | \$835   | \$885   | 37.41   | 0.30  |
| A6 | BUILDING #473<br>CLASSIFICATION         | -11 | \$11   | \$2,565 | \$2,719 | 85.80   | -0.03 |
| A6 | BUILDING #475A<br>INVESTIGATION         | 32  | \$406  | \$8,020 | \$8,501 | 20.22   | 0.55  |
| A6 | BUILDING #475B<br>DINING / LIBRARY      | 6   | \$74   | \$2,774 | \$2,940 | 37.12   | 0.30  |
| A6 | BUILDING #475H<br>MSA / D&A BOARD / TDS | 5   | \$60   | \$2,610 | \$2,767 | 42.26   | 0.26  |

### EXTERIOR WALL INSULATION

|    |   |     |         |           |           |        |      |
|----|---|-----|---------|-----------|-----------|--------|------|
| A7 | BUILDING #472<br>PRINT SHOP / COLLEGE   | 229 | \$1,507 | \$57,916  | \$61,391  | 54.83  | 0.28 |
| A7 | BUILDING #475C<br>HSG. UNIT / RECEPTION | 154 | \$628   | \$158,675 | \$168,196 | 253.55 | 0.06 |

### ARCHITECTURAL REPAIRS

|    |  |  |  |          |          |  |  |
|----|--|--|--|----------|----------|--|--|
| A9 | BUILDING #463<br>SOUTH GATE / VISITORS   |  |  | \$424    | \$449    |  |  |
| A9 | BUILDING #465<br>INSIDE BARBER SHOP      |  |  | \$1,671  | \$1,771  |  |  |
| A9 | BUILDING #466<br>CARPENTRY SHOP          |  |  | \$582    | \$617    |  |  |
| A9 | BUILDING #472<br>PRINT SHOP / COLLEGE    |  |  | \$1,219  | \$1,292  |  |  |
| A9 | BUILDING #473<br>CLASSIFICATION          |  |  | \$2,132  | \$2,260  |  |  |
| A9 | BUILDING #475<br>ROTUNDA                 |  |  | \$13,727 | \$14,551 |  |  |
| A9 | BUILDING #475A<br>INVESTIGATION          |  |  | \$1,221  | \$1,294  |  |  |
| A9 | BUILDING #475E<br>DINING / LAUNDRY / GYM |  |  | \$50,302 | \$53,320 |  |  |

### SCHEDULE AIR HANDLING EQUIPMENT

|    |  |     |       |         |         |       |      |
|----|--|-----|-------|---------|---------|-------|------|
| M1 | BUILDING #463<br>SOUTH GATE / VISITORS | 10  | \$51  | \$464   | \$492   | 9.32  | 0.93 |
| M1 | BUILDING #464<br>OUTSIDE BARBER SHOP   | 45  | \$396 | \$8,731 | \$9,255 | 21.85 | 0.42 |
| M1 | BUILDING #465<br>INSIDE BARBER SHOP    | 280 | \$891 | \$9,408 | \$9,972 | 10.57 | 1.03 |

### DRY-BULB ECONOMIZER CONTROLS

|    |  |    |       |         |         |        |      |
|----|--|----|-------|---------|---------|--------|------|
| M2 | BUILDING #463<br>SOUTH GATE / VISITORS | 0  | \$3   | \$1,459 | \$1,547 | 488.00 | 0.02 |
| M2 | BUILDING #464<br>OUTSIDE BARBER SHOP   | 13 | \$156 | \$1,333 | \$1,413 | 8.85   | 0.97 |
| M2 | BUILDING #473<br>CLASSIFICATION        | 1  | \$7   | \$1,333 | \$1,413 | 191.00 | 0.05 |

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S INVESTIGATED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|------------------------|----------------------------|-----|

### SERVICE STEAM PIPING AND TRAPS

|    |                 |       |         |          |          |      |      |
|----|-----------------|-------|---------|----------|----------|------|------|
| M3 | OWNER TESTING   | 1,510 | \$6,161 | \$15,738 | \$16,682 | 2.56 | 4.55 |
| M3 | OUTSIDE TESTING | 1,510 | \$6,161 | \$16,150 | \$17,119 | 2.63 | 4.44 |

### EXHAUST HEAT RECOVERY

|    |               |     |         |          |          |       |      |
|----|---------------|-----|---------|----------|----------|-------|------|
| M5 | Q-DOT SYSTEM  | 453 | \$2,130 | \$12,178 | \$12,909 | 6.66  | 1.76 |
| M5 | Z-DUCT SYSTEM | 294 | \$1,568 | \$12,795 | \$13,563 | 10.81 | 1.08 |
| M5 | COIL LOOP     | 301 | \$953   | \$15,352 | \$16,273 | 12.81 | 0.92 |

### INSULATE DUCTWORK

|    |                                       |  |  |  |  |  |  |
|----|---------------------------------------|--|--|--|--|--|--|
| M6 | THIS ECO IS NOT<br>NOT COST EFFECTIVE |  |  |  |  |  |  |
|----|---------------------------------------|--|--|--|--|--|--|

### CENTRAL PLANT COOLING

|     |                                       |     |         |           |           |        |      |
|-----|---------------------------------------|-----|---------|-----------|-----------|--------|------|
| M10 | ALL BUILDINGS IN THE<br>USDB FACILITY | 220 | \$2,737 | \$444,542 | \$471,215 | 162.99 | 0.05 |
|-----|---------------------------------------|-----|---------|-----------|-----------|--------|------|

### CASTLE AIR SYSTEM REPAIR

|     |   |     |         |         |         |      |      |
|-----|---|-----|---------|---------|---------|------|------|
| M11 | BUILDING #475C<br>HSG. UNIT / RECEPTION | 273 | \$1,458 | \$1,678 | \$1,779 | 1.51 | 7.72 |
| M11 | BUILDING #475D<br>HSG. UNIT / 4-BASE    | 277 | \$1,474 | \$1,678 | \$1,779 | 1.49 | 7.83 |
| M11 | BUILDING #475F<br>HSG. UNIT             | 307 | \$1,641 | \$1,678 | \$1,779 | 1.34 | 8.68 |
| M11 | BUILDING #475G<br>HSG. UNIT             | 247 | \$1,323 | \$1,678 | \$1,779 | 1.67 | 6.99 |

### REDUCE STEAM DISTRIBUTION PRESSURE

|     |                                       |     |         |         |         |      |      |
|-----|---------------------------------------|-----|---------|---------|---------|------|------|
| M12 | ALL BUILDINGS IN THE<br>USDB FACILITY | 605 | \$2,470 | \$9,369 | \$9,931 | 3.81 | 3.06 |
|-----|---------------------------------------|-----|---------|---------|---------|------|------|

### CONDENSATE RETURN SYSTEM SERVICE

|     |                                       |       |         |          |          |      |      |
|-----|---------------------------------------|-------|---------|----------|----------|------|------|
| M14 | ALL BUILDINGS IN THE<br>USDB FACILITY | 1,687 | \$6,883 | \$35,958 | \$38,115 | 5.24 | 2.23 |
|-----|---------------------------------------|-------|---------|----------|----------|------|------|

### BOILER PLANT MODIFICATIONS

|     |                             |       |          |          |          |       |      |
|-----|-----------------------------|-------|----------|----------|----------|-------|------|
| M15 | ECONOMIZER<br>HEAT RECOVERY | 280   | \$1,142  | \$22,852 | \$24,223 | 20.08 | 0.58 |
| M15 | OXYGEN TRIM<br>CONTROLS     | 3,397 | \$13,860 | \$36,865 | \$39,077 | 2.67  | 4.37 |

### CONVERT FROM STEAM TO HOT WATER

|     |                                       |        |          |           |           |       |      |
|-----|---------------------------------------|--------|----------|-----------|-----------|-------|------|
| M24 | ALL BUILDINGS IN THE<br>USDB FACILITY | 14,464 | \$52,024 | \$634,367 | \$672,429 | 12.24 | 1.00 |
|-----|---------------------------------------|--------|----------|-----------|-----------|-------|------|

### CONVERT FROM STEAM TO COGENERATION

|     |                                       |  |          |             |             |       |  |
|-----|---------------------------------------|--|----------|-------------|-------------|-------|--|
| M25 | ALL BUILDINGS IN THE<br>USDB FACILITY |  | \$58,138 | \$1,200,000 | \$1,272,000 | 21.00 |  |
|-----|---------------------------------------|--|----------|-------------|-------------|-------|--|

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S INVESTIGATED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL<br>PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|

### REDUCE HOT WATER TEMPERATURE

|     |  |    |       |     |     |             |  |
|-----|--|----|-------|-----|-----|-------------|--|
| M26 | BUILDING #475<br>ROTUNDA                   | 23 | \$92  | \$0 | \$0 | IMMEDIATELY |  |
| M26 | CASTLE BUILDINGS<br>475C, 475D, 475F, 475G | 51 | \$210 | \$0 | \$0 | IMMEDIATELY |  |
| M26 | BUILDING #475E<br>DINING / LAUNDRY / GYM   | 33 | \$134 | \$0 | \$0 | IMMEDIATELY |  |
| M26 | TUNNELS                                    | 73 | \$299 | \$0 | \$0 | IMMEDIATELY |  |

### DECENTRALIZE HOT WATER SYSTEM

|     |  |     |         |          |          |       |      |
|-----|--|-----|---------|----------|----------|-------|------|
| M29 | BLDGS. 450, 463, 464,<br>466, 467, 468, 472, & 473 | 243 | \$1,296 | \$19,599 | \$20,775 | 19.85 | 0.59 |
|-----|--|-----|---------|----------|----------|-------|------|

### DOMESTIC WATER PIPE INSULATION

|     |                 |     |       |         |         |      |      |
|-----|-----------------|-----|-------|---------|---------|------|------|
| M30 | CASTLE BUILDING | 147 | \$787 | \$1,365 | \$1,447 | 2.28 | 5.11 |
| M30 | PIPE TUNNELS    | 55  | \$293 | \$454   | \$481   | 2.03 | 5.75 |

### HEAT RECOVERY FOR LAUNDRY

|     |                                |       |          |           |           |       |      |
|-----|--------------------------------|-------|----------|-----------|-----------|-------|------|
| M31 | WASH WATER<br>HEAT RECOVERY    | 3,871 | \$15,742 | \$43,829  | \$46,459  | 2.79  | 4.18 |
| M31 | DRYER EXHAUST<br>HEAT RECOVERY | 2,748 | \$10,597 | \$111,688 | \$118,389 | 10.58 | 1.13 |

### WATER HEATING HEAT PUMPS

|     |   |     |         |           |           |        |      |
|-----|---|-----|---------|-----------|-----------|--------|------|
| M39 | BUILDING #450<br>MENTALHYGIENE          | 9   | \$117   | \$73,293  | \$77,691  | 656.70 | 0.01 |
| M39 | BUILDING #463<br>SOUTH GATE / VISITORS  | 1   | \$106   | \$53,565  | \$56,779  | 521.87 | 0.02 |
| M39 | BUILDING #464<br>OUTSIDE BARBER SHOP    | 16  | \$163   | \$59,685  | \$63,266  | 34.46  | 0.34 |
| M39 | BUILDING #465<br>INSIDE BARBER SHOP     | 307 | \$1,342 | \$39,012  | \$41,353  | 29.11  | 0.39 |
| M39 | BUILDING #472<br>PRINT SHOP / COLLEGE   | 166 | \$851   | \$159,692 | \$169,274 | 189.65 | 0.06 |
| M39 | BUILDING #473<br>CLASSIFICATION         | 17  | \$212   | \$86,261  | \$91,437  | 410.25 | 0.02 |
| M39 | BUILDING #475A<br>INVESTIGATION         | 20  | \$249   | \$97,188  | \$103,019 | 391.68 | 0.02 |
| M39 | BUILDING #475B<br>DINING / LIBRARY      | 12  | \$154   | \$61,228  | \$64,902  | 412.37 | 0.02 |
| M39 | BUILDING #475H<br>MSA / D&A BOARD / TDS | 9   | \$115   | \$46,915  | \$49,730  | 420.35 | 0.02 |

### LIGHTING LEVELS

|    |                                   |   |      |       |       |       |      |
|----|-----------------------------------|---|------|-------|-------|-------|------|
| E1 | BUILDING #450<br>CONFERENCE ROOM  | 3 | \$34 | \$201 | \$213 | 5.90  | 1.90 |
| E1 | BUILDING #475A<br>CONFERENCE ROOM | 1 | \$17 | \$201 | \$213 | 11.80 | 0.90 |
| E1 | BUILDING #475A<br>CHAPEL          | 3 | \$43 | \$201 | \$213 | 4.70  | 2.40 |
| E1 | BUILDING #475E<br>CONFERENCE ROOM | 1 | \$13 | \$201 | \$213 | 15.70 | 0.70 |
| E1 | BUILDING #475B<br>CHAPEL          | 3 | \$40 | \$201 | \$213 | 5.00  | 2.20 |
| E1 | BUILDING #475H<br>CHAPEL          | 2 | \$21 | \$201 | \$213 | 9.50  | 1.20 |



# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S INVESTIGATED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|------------------------|----------------------------|-----|

## ENERGY EFFICIENT LIGHTING SYSTEMS

|    |                                 |   |       |       |       |      |      |
|----|---------------------------------|---|-------|-------|-------|------|------|
| E2 | BUILDING #475A<br>INVESTIGATION | 8 | \$100 | \$124 | \$131 | 1.24 | 9.00 |
|----|---------------------------------|---|-------|-------|-------|------|------|

## ENERGY EFFICIENT MOTORS

|    |                                       |     |         |          |          |      |      |
|----|---------------------------------------|-----|---------|----------|----------|------|------|
| E3 | ALL BUILDINGS IN THE<br>USDB FACILITY | 248 | \$3,085 | \$20,929 | \$22,185 | 6.80 | 1.60 |
|----|---------------------------------------|-----|---------|----------|----------|------|------|

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S RECOMMENDED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL<br>PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|

### ATTIC INSULATION

|    |                                       |     |       |         |         |         |      |
|----|---------------------------------------|-----|-------|---------|---------|---------|------|
| A3 | BUILDING #464<br>OUTSIDE BARBER SHOP  | 106 | \$583 | \$3,215 | \$3,408 | 5.54    | 2.57 |
| A3 | BUILDING #472<br>PRINT SHOP / COLLEGE | 34  | \$194 | \$2,438 | \$2,584 | 11.72** | 1.19 |
| A3 | BUILDING #475<br>ROTUNDA              | 142 | \$578 | \$4,592 | \$4,868 | 7.96    | 2.03 |

### DOCK DOOR REPLACEMENT

|    |                                       |    |      |       |       |         |      |
|----|---------------------------------------|----|------|-------|-------|---------|------|
| A4 | BUILDING #470<br>POPE HALL / VOC SHOP | 17 | \$69 | \$870 | \$922 | 12.65** | 1.28 |
|----|---------------------------------------|----|------|-------|-------|---------|------|

### SOLAR WINDOW SHADING

|    |                                 |    |       |         |         |      |      |
|----|---------------------------------|----|-------|---------|---------|------|------|
| A6 | BUILDING #450<br>MENTAL HYGIENE | 80 | \$498 | \$2,001 | \$2,121 | 5.00 | 2.96 |
|----|---------------------------------|----|-------|---------|---------|------|------|

### SCHEDULE AIR HANDLING EQUIPMENT

|    |                                     |     |       |         |         |         |      |
|----|-------------------------------------|-----|-------|---------|---------|---------|------|
| M1 | BUILDING #465<br>INSIDE BARBER SHOP | 280 | \$891 | \$9,408 | \$9,972 | 10.57** | 1.03 |
|----|-------------------------------------|-----|-------|---------|---------|---------|------|

### SERVICE STEAM PIPING AND TRAPS

|    |                 |       |         |          |          |      |      |
|----|-----------------|-------|---------|----------|----------|------|------|
| M3 | OWNER TESTING   | 1,510 | \$6,161 | \$15,738 | \$16,682 | 2.56 | 4.55 |
| M3 | OUTSIDE TESTING | 1,510 | \$6,161 | \$16,150 | \$17,119 | 2.63 | 4.44 |

### EXHAUST HEAT RECOVERY

|    |               |     |         |          |          |         |      |
|----|---------------|-----|---------|----------|----------|---------|------|
| M5 | Q-DOT SYSTEM  | 453 | \$2,130 | \$12,178 | \$12,909 | 6.66    | 1.76 |
| M5 | Z-DUCT SYSTEM | 294 | \$1,568 | \$12,795 | \$13,563 | 10.81** | 1.08 |

### CASTLE AIR SYSTEM REPAIR

|     |   |     |         |         |         |      |      |
|-----|---|-----|---------|---------|---------|------|------|
| M11 | BUILDING #475C<br>HSG. UNIT / RECEPTION | 273 | \$1,458 | \$1,678 | \$1,779 | 1.51 | 7.72 |
| M11 | BUILDING #475D<br>HSG. UNIT / 4-BASE    | 277 | \$1,474 | \$1,678 | \$1,779 | 1.49 | 7.83 |
| M11 | BUILDING #475F<br>HSG. UNIT             | 307 | \$1,641 | \$1,678 | \$1,779 | 1.34 | 8.68 |
| M11 | BUILDING #475G<br>HSG. UNIT             | 247 | \$1,323 | \$1,678 | \$1,779 | 1.67 | 6.99 |

### REDUCE STEAM DISTRIBUTION PRESSURE

|     |                                       |     |         |         |         |      |      |
|-----|---------------------------------------|-----|---------|---------|---------|------|------|
| M12 | ALL BUILDINGS IN THE<br>USDB FACILITY | 605 | \$2,470 | \$9,369 | \$9,931 | 3.81 | 3.06 |
|-----|---------------------------------------|-----|---------|---------|---------|------|------|

### CONDENSATE RETURN SYSTEM SERVICE

|     |                                       |       |         |          |          |      |      |
|-----|---------------------------------------|-------|---------|----------|----------|------|------|
| M14 | ALL BUILDINGS IN THE<br>USDB FACILITY | 1,687 | \$6,883 | \$35,958 | \$38,115 | 5.24 | 2.23 |
|-----|---------------------------------------|-------|---------|----------|----------|------|------|

### BOILER PLANT MODIFICATIONS

|     |                         |       |          |          |          |      |      |
|-----|-------------------------|-------|----------|----------|----------|------|------|
| M15 | OXYGEN TRIM<br>CONTROLS | 3,397 | \$13,860 | \$36,865 | \$39,077 | 2.67 | 4.37 |
|-----|-------------------------|-------|----------|----------|----------|------|------|

\*TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

\*\* PB > 10 YEARS; PROJECT NOT AVAILABLE FOR FUNDING.

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S RECOMMENDED

| ECO | BUILDING NAME | ENERGY SAVINGS<br>MBTU'S/YR | ENERGY SAVINGS<br>(\$) | CONSTRUCTION<br>COST | TOTAL<br>PROJECT<br>COST* | SIMPLE<br>PAYBACK<br>YEARS | SIR |
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|
|-----|---------------|-----------------------------|------------------------|----------------------|---------------------------|----------------------------|-----|

### REDUCE HOT WATER TEMPERATURE

|     |  |    |       |     |     |             |  |
|-----|--|----|-------|-----|-----|-------------|--|
| M26 | BUILDING #475<br>ROTUNDA                   | 23 | \$92  | \$0 | \$0 | IMMEDIATELY |  |
| M26 | CASTLE BUILDINGS<br>475C, 475D, 475F, 475G | 51 | \$210 | \$0 | \$0 | IMMEDIATELY |  |
| M26 | BUILDING #475E<br>DINING / LAUNDRY / GYM   | 33 | \$134 | \$0 | \$0 | IMMEDIATELY |  |
| M26 | TUNNELS                                    | 73 | \$299 | \$0 | \$0 | IMMEDIATELY |  |

### DOMESTIC WATER PIPE INSULATION

|     |                 |     |       |         |         |      |      |
|-----|-----------------|-----|-------|---------|---------|------|------|
| M30 | CASTLE BUILDING | 147 | \$787 | \$1,365 | \$1,447 | 2.28 | 5.11 |
| M30 | PIPE TUNNELS    | 55  | \$293 | \$454   | \$481   | 2.03 | 5.75 |

### HEAT RECOVERY FOR LAUNDRY

|     |                                |       |          |           |           |         |      |
|-----|--------------------------------|-------|----------|-----------|-----------|---------|------|
| M31 | WASH WATER<br>HEAT RECOVERY    | 3,871 | \$15,742 | \$43,829  | \$46,459  | 2.79    | 4.18 |
| M31 | DRYER EXHAUST<br>HEAT RECOVERY | 2,748 | \$10,597 | \$111,688 | \$118,389 | 10.58** | 1.13 |

### LIGHTING LEVELS

|    |                                  |   |      |       |       |      |      |
|----|----------------------------------|---|------|-------|-------|------|------|
| E1 | BUILDING #450<br>CONFERENCE ROOM | 3 | \$34 | \$201 | \$213 | 5.90 | 1.90 |
| E1 | BUILDING #475A<br>CHAPEL         | 3 | \$43 | \$201 | \$213 | 4.70 | 2.40 |
| E1 | BUILDING #475B<br>CHAPEL         | 3 | \$40 | \$201 | \$213 | 5.00 | 2.20 |
| E1 | BUILDING #475H<br>CHAPEL         | 2 | \$21 | \$201 | \$213 | 9.50 | 1.20 |

### ENERGY EFFICIENT LIGHTING SYSTEMS

|    |                                 |   |       |       |       |      |      |
|----|---------------------------------|---|-------|-------|-------|------|------|
| E2 | BUILDING #475A<br>INVESTIGATION | 8 | \$100 | \$124 | \$131 | 1.24 | 9.00 |
|----|---------------------------------|---|-------|-------|-------|------|------|

### ENERGY EFFICIENT MOTORS

|    |                                       |     |         |          |          |      |      |
|----|---------------------------------------|-----|---------|----------|----------|------|------|
| E3 | ALL BUILDINGS IN THE<br>USDB FACILITY | 248 | \$3,085 | \$20,929 | \$22,185 | 6.80 | 1.60 |
|----|---------------------------------------|-----|---------|----------|----------|------|------|

\*TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

\*\* PB > 10 YEARS; PROJECT NOT AVAILABLE FOR FUNDING.

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S REJECTED

| ECO | BUILDING NAME | ENERGY SAVINGS MBTU'S/YR | ENERGY SAVINGS (\$) | CONSTRUCTION COST | TOTAL PROJECT COST* | SIMPLE PAYBACK YEARS | SIR |
|-----|---------------|--------------------------|---------------------|-------------------|---------------------|----------------------|-----|
|-----|---------------|--------------------------|---------------------|-------------------|---------------------|----------------------|-----|

### REDUCE INFILTRATION

|    |  |     |         |          |          |         |      |
|----|--|-----|---------|----------|----------|---------|------|
| A1 | BUILDING #463<br>SOUTH GATE / VISITORS   | 12  | \$49    | \$10,617 | \$11,254 | 217.43  | 0.07 |
| A1 | BUILDING #464<br>OUTSIDE BARBER SHOP     | 9   | \$42    | \$5,549  | \$5,882  | 123.73  | 0.12 |
| A1 | BUILDING #465<br>INSIDE BARBER SHOP      | 256 | \$1,061 | \$61,405 | \$65,089 | 58.08   | 0.28 |
| A1 | BUILDING #466<br>CARPENTRY SHOP          | 1   | \$8     | \$18,112 | \$19,199 | 4544.00 | 0.00 |
| A1 | BUILDING #472<br>PRINT SHOP / COLLEGE    | 62  | \$265   | \$25,015 | \$26,516 | 96.18   | 0.17 |
| A1 | BUILDING #473<br>CLASSIFICATION          | 12  | \$54    | \$12,250 | \$12,985 | 215.67  | 0.07 |
| A1 | BUILDING #475<br>ROTUNDA                 | 15  | \$59    | \$7,865  | \$8,337  | 129.39  | 0.12 |
| A1 | BUILDING #475A<br>INVESTIGATION          | 93  | \$399   | \$9,504  | \$10,074 | 23.61   | 0.66 |
| A1 | BUILDING #475B<br>DINING / LIBRARY       | 16  | \$65    | \$9,793  | \$10,381 | 151.20  | 0.11 |
| A1 | BUILDING #475C<br>HSG. UNIT / RECEPTION  | 42  | \$171   | \$31,812 | \$33,721 | 186.69  | 0.09 |
| A1 | BUILDING #475D<br>HSG. UNIT / 4-BASE     | 48  | \$195   | \$37,748 | \$40,013 | 193.27  | 0.08 |
| A1 | BUILDING #475E<br>DINING / LAUNDRY / GYM | 53  | \$146   | \$42,102 | \$44,628 | 283.56  | 0.07 |
| A1 | BUILDING #475F<br>HSG. UNIT              | 89  | \$365   | \$37,990 | \$40,269 | 105.02  | 0.15 |
| A1 | BUILDING #475G<br>HSG. UNIT              | 41  | \$169   | \$32,708 | \$34,670 | 196.54  | 0.08 |
| A1 | BUILDING #475H<br>MSA / D&A BOARD / TDS  | 20  | \$85    | \$7,563  | \$8,017  | 92.50   | 0.17 |

### WINDOW REPLACEMENT

|    |   |     |       |           |           |        |      |
|----|---|-----|-------|-----------|-----------|--------|------|
| A2 | BUILDING #450<br>MENTAL HYGIENE         | 104 | \$455 | \$34,048  | \$36,091  | 74.60  | 0.21 |
| A2 | BUILDING #465<br>INSIDE BARBER SHOP     | 217 | \$892 | \$369,241 | \$391,395 | 414.93 | 0.04 |
| A2 | BUILDING #475<br>ROTUNDA                | 78  | \$317 | \$104,902 | \$111,196 | 331.03 | 0.05 |
| A2 | BUILDING #475C<br>HSG. UNIT / RECEPTION | 161 | \$658 | \$208,538 | \$221,050 | 318.52 | 0.05 |
| A2 | BUILDING #475D<br>HSG. UNIT / 4-BASE    | 237 | \$967 | \$244,911 | \$259,606 | 254.16 | 0.06 |
| A2 | BUILDING #475F<br>HSG. UNIT             | 186 | \$761 | \$244,911 | \$259,606 | 323.81 | 0.05 |
| A2 | BUILDING #475G<br>HSG. UNIT / FEM HSG   | 164 | \$671 | \$208,538 | \$221,050 | 312.81 | 0.05 |

### ATTIC INSULATION

|    |  |    |       |          |          |        |      |
|----|--|----|-------|----------|----------|--------|------|
| A3 | BUILDING #475E<br>DINING / LAUNDRY / GYM | 40 | \$169 | \$30,487 | \$32,316 | 187.69 | 0.09 |
|----|--|----|-------|----------|----------|--------|------|

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S REJECTED

| ECO | BUILDING NAME | ENERGY SAVINGS MBTU'S/YR | ENERGY SAVINGS (\$) | CONSTRUCTION COST | TOTAL PROJECT COST* | SIMPLE PAYBACK YEARS | SIR |
|-----|---------------|--------------------------|---------------------|-------------------|---------------------|----------------------|-----|
|-----|---------------|--------------------------|---------------------|-------------------|---------------------|----------------------|-----|

### VESTIBULES

|    |  |    |      |          |          |         |      |
|----|--|----|------|----------|----------|---------|------|
| A5 | BUILDING #463<br>SOUTH GATE / VISITORS | 12 | \$49 | \$88,238 | \$93,532 | 1807.08 | 0.01 |
|----|--|----|------|----------|----------|---------|------|

### SOLAR WINDOW SHADING

|    |   |     |        |         |         |         |       |
|----|---|-----|--------|---------|---------|---------|-------|
| A6 | BUILDING #463<br>SOUTH GATE / VISITORS  | -17 | (\$53) | \$2,056 | \$2,179 | -73.68  | -0.37 |
| A6 | BUILDING #464<br>OUTSIDE BARBER SHOP    | -11 | (\$26) | \$1,782 | \$1,889 | -596.00 | -0.20 |
| A6 | BUILDING #472<br>PRINT SHOP / COLLEGE   | 18  | \$74   | \$835   | \$885   | 37.41   | 0.30  |
| A6 | BUILDING #473<br>CLASSIFICATION         | -11 | \$11   | \$2,565 | \$2,719 | 85.80   | -0.03 |
| A6 | BUILDING #475A<br>INVESTIGATION         | 32  | \$406  | \$8,020 | \$8,501 | 20.22   | 0.55  |
| A6 | BUILDING #475B<br>DINING / LIBRARY      | 6   | \$74   | \$2,774 | \$2,940 | 37.12   | 0.30  |
| A6 | BUILDING #475H<br>MSA / D&A BOARD / TDS | 5   | \$60   | \$2,610 | \$2,767 | 42.26   | 0.26  |

### EXTERIOR WALL INSULATION

|    |   |     |         |           |           |        |      |
|----|---|-----|---------|-----------|-----------|--------|------|
| A7 | BUILDING #472<br>PRINT SHOP / COLLEGE   | 229 | \$1,507 | \$57,916  | \$61,391  | 54.83  | 0.28 |
| A7 | BUILDING #475C<br>HSG. UNIT / RECEPTION | 154 | \$628   | \$158,675 | \$168,196 | 253.55 | 0.06 |

### ARCHITECTURAL REPAIRS

|    |  |  |  |          |          |  |  |
|----|--|--|--|----------|----------|--|--|
| A9 | BUILDING #463<br>SOUTH GATE / VISITORS   |  |  | \$424    | \$449    |  |  |
| A9 | BUILDING #465<br>INSIDE BARBER SHOP      |  |  | \$1,671  | \$1,771  |  |  |
| A9 | BUILDING #466<br>CARPENTRY SHOP          |  |  | \$582    | \$617    |  |  |
| A9 | BUILDING #472<br>PRINT SHOP / COLLEGE    |  |  | \$1,219  | \$1,292  |  |  |
| A9 | BUILDING #473<br>CLASSIFICATION          |  |  | \$2,132  | \$2,260  |  |  |
| A9 | BUILDING #475<br>ROTUNDA                 |  |  | \$13,727 | \$14,551 |  |  |
| A9 | BUILDING #475A<br>INVESTIGATION          |  |  | \$1,221  | \$1,294  |  |  |
| A9 | BUILDING #475E<br>DINING / LAUNDRY / GYM |  |  | \$50,302 | \$53,320 |  |  |

### SCHEDULE AIR HANDLING EQUIPMENT

|    |  |    |       |         |         |       |      |
|----|--|----|-------|---------|---------|-------|------|
| M1 | BUILDING #463<br>SOUTH GATE / VISITORS | 10 | \$51  | \$464   | \$492   | 9.32  | 0.93 |
| M1 | BUILDING #464<br>OUTSIDE BARBER SHOP   | 45 | \$396 | \$8,731 | \$9,255 | 21.85 | 0.42 |

### DRY-BULB ECONOMIZER CONTROLS

|    |  |    |       |         |         |        |      |
|----|--|----|-------|---------|---------|--------|------|
| M2 | BUILDING #463<br>SOUTH GATE / VISITORS | 0  | \$3   | \$1,459 | \$1,547 | 488.00 | 0.02 |
| M2 | BUILDING #464<br>OUTSIDE BARBER SHOP   | 13 | \$156 | \$1,333 | \$1,413 | 8.85   | 0.97 |
| M2 | BUILDING #473<br>CLASSIFICATION        | 1  | \$7   | \$1,333 | \$1,413 | 191.00 | 0.05 |

### EXHAUST HEAT RECOVERY

|    |           |     |       |          |          |       |      |
|----|-----------|-----|-------|----------|----------|-------|------|
| M5 | COIL LOOP | 301 | \$953 | \$15,352 | \$16,273 | 12.81 | 0.92 |
|----|-----------|-----|-------|----------|----------|-------|------|

# ENERGY CONSERVATION ANALYSIS

## ALL ECO'S REJECTED

| ECO | BUILDING NAME | ENERGY SAVINGS MBTU'S/YR | ENERGY SAVINGS (\$) | CONSTRUCTION COST | TOTAL PROJECT COST* | SIMPLE PAYBACK YEARS | SIR |
|-----|---------------|--------------------------|---------------------|-------------------|---------------------|----------------------|-----|
|-----|---------------|--------------------------|---------------------|-------------------|---------------------|----------------------|-----|

### INSULATE DUCTWORK

|    |                                    |  |  |  |  |  |  |
|----|------------------------------------|--|--|--|--|--|--|
| M6 | THIS ECO IS NOT NOT COST EFFECTIVE |  |  |  |  |  |  |
|----|------------------------------------|--|--|--|--|--|--|

### CENTRAL PLANT COOLING

|     |                                    |     |         |           |           |        |      |
|-----|------------------------------------|-----|---------|-----------|-----------|--------|------|
| M10 | ALL BUILDINGS IN THE USDB FACILITY | 220 | \$2,737 | \$444,542 | \$471,215 | 162.99 | 0.05 |
|-----|------------------------------------|-----|---------|-----------|-----------|--------|------|

### BOILER PLANT MODIFICATIONS

|     |                          |     |         |          |          |       |      |
|-----|--------------------------|-----|---------|----------|----------|-------|------|
| M15 | ECONOMIZER HEAT RECOVERY | 280 | \$1,142 | \$22,852 | \$24,223 | 20.08 | 0.58 |
|-----|--------------------------|-----|---------|----------|----------|-------|------|

### CONVERT FROM STEAM TO HOT WATER

|     |                                    |        |          |           |           |       |      |
|-----|------------------------------------|--------|----------|-----------|-----------|-------|------|
| M24 | ALL BUILDINGS IN THE USDB FACILITY | 14,464 | \$52,024 | \$634,367 | \$672,429 | 12.24 | 1.00 |
|-----|------------------------------------|--------|----------|-----------|-----------|-------|------|

### CONVERT FROM STEAM TO COGENERATION

|     |                                    |  |          |             |             |       |  |
|-----|------------------------------------|--|----------|-------------|-------------|-------|--|
| M25 | ALL BUILDINGS IN THE USDB FACILITY |  | \$58,138 | \$1,200,000 | \$1,272,000 | 21.00 |  |
|-----|------------------------------------|--|----------|-------------|-------------|-------|--|

### DECENTRALIZE HOT WATER SYSTEM

|     |   |     |         |          |          |       |      |
|-----|---|-----|---------|----------|----------|-------|------|
| M29 | BLDGS. 450, 463, 464, 466, 467, 468, 472, & 473 | 243 | \$1,296 | \$19,599 | \$20,775 | 19.85 | 0.59 |
|-----|---|-----|---------|----------|----------|-------|------|

### WATER HEATING HEAT PUMPS

|     |                                      |     |         |           |           |        |      |
|-----|--------------------------------------|-----|---------|-----------|-----------|--------|------|
| M39 | BUILDING #450 MENTALHYGIENE          | 9   | \$117   | \$73,293  | \$77,691  | 656.70 | 0.01 |
| M39 | BUILDING #463 SOUTH GATE / VISITORS  | 1   | \$106   | \$53,565  | \$56,779  | 521.87 | 0.02 |
| M39 | BUILDING #464 OUTSIDE BARBER SHOP    | 16  | \$163   | \$59,685  | \$63,266  | 34.46  | 0.34 |
| M39 | BUILDING #465 INSIDE BARBER SHOP     | 307 | \$1,342 | \$39,012  | \$41,353  | 29.11  | 0.39 |
| M39 | BUILDING #472 PRINT SHOP / COLLEGE   | 166 | \$851   | \$159,692 | \$169,274 | 189.65 | 0.06 |
| M39 | BUILDING #473 CLASSIFICATION         | 17  | \$212   | \$86,261  | \$91,437  | 410.25 | 0.02 |
| M39 | BUILDING #475A INVESTIGATION         | 20  | \$249   | \$97,188  | \$103,019 | 391.68 | 0.02 |
| M39 | BUILDING #475B DINING / LIBRARY      | 12  | \$154   | \$61,228  | \$64,902  | 412.37 | 0.02 |
| M39 | BUILDING #475H MSA / D&A BOARD / TDS | 9   | \$115   | \$46,915  | \$49,730  | 420.35 | 0.02 |

### LIGHTING LEVELS

|    |                                |   |      |       |       |       |      |
|----|--------------------------------|---|------|-------|-------|-------|------|
| E1 | BUILDING #475A CONFERENCE ROOM | 1 | \$17 | \$201 | \$213 | 11.80 | 0.90 |
| E1 | BUILDING #475E CONFERENCE ROOM | 1 | \$13 | \$201 | \$213 | 15.70 | 0.70 |

\* TOTAL PROJECT COST IS CONSTRUCTION COST + 6% SIOH

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                                     | ECO     | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR         |
|---|---------|------------------------------|-------------------------|-----------------------|--------------------------|-------------|
| <b>GROUP 1</b><br>In House Low Cost No Cost       |         |                              |                         |                       |                          |             |
| 470 Building 470                                  | ECO-A4  | 17                           | \$69                    | \$922                 | 12.65                    | 1.28        |
| 464 Building 464                                  | ECO-A3  | 106                          | \$583                   | \$3,408               | 5.54                     | 2.57        |
| 475 Building 475                                  | ECO-M26 | 23                           | \$92                    | \$0                   |                          |             |
| Buildings 475C, 475D,<br>475F, and 475G           | ECO-M26 | 51                           | \$210                   | \$0                   |                          |             |
| Tunnels   | ECO-M26 | 73                           | \$299                   | \$0                   |                          |             |
| <b>GROUP 1 TOTALS</b>                             |         | <b>270</b>                   | <b>\$1,253</b>          | <b>\$4,330</b>        | <b>6.09</b>              | <b>1.75</b> |
| <b>GROUP 1 FUNDING CATEGORY: LOW COST/NO COST</b> |         |                              |                         |                       |                          |             |
| <b>GROUP 2</b><br>Laundry Heat Recovery           |         |                              |                         |                       |                          |             |
| 474 Wash Water Heat Recovery                      | ECO-M31 | 3,871                        | \$15,742                | \$46,459              | 2.79                     | 4.18        |
| <b>GROUP 2 TOTALS</b>                             |         | <b>3,871</b>                 | <b>\$15,742</b>         | <b>\$46,459</b>       | <b>2.79</b>              | <b>4.18</b> |
| <b>GROUP 2 FUNDING CATEGORY: PECIP</b>            |         |                              |                         |                       |                          |             |
| <b>GROUP 3</b><br>Insulate Water Piping           |         |                              |                         |                       |                          |             |
| 475 Castle Building                               | M30     | 147                          | 787                     | \$1,447               | 2.28                     | 5.11        |
| Pipe Tunnels                                      | M30     | 55                           | 293                     | \$481                 | 2.03                     | 5.75        |
| <b>GROUP 3 TOTALS</b>                             |         | <b>202</b>                   | <b>\$1,080</b>          | <b>\$1,928</b>        | <b>2.21</b>              | <b>5.27</b> |
| <b>GROUP 3 FUNDING CATEGORY: LOW COST/NO COST</b> |         |                              |                         |                       |                          |             |
| <b>GROUP 4</b><br>Power Plant                     |         |                              |                         |                       |                          |             |
| 474 Outside Testing - Steam Traps                 | M3      | 1,510                        | \$6,161                 | \$17,119              | 2.63                     | 4.44        |
| 474 Reduce Steam Pressure                         | M12     | 605                          | \$2,470                 | \$9,931               | 3.81                     | 3.06        |
| 474 Condensate Return System                      | M14     | 1,687                        | \$6,883                 | \$38,115              | 5.24                     | 2.23        |
| 474 Oxygen Trim Controls                          | M15     | 3,397                        | \$13,860                | \$39,077              | 2.67                     | 4.37        |
| <b>GROUP 4 TOTALS</b>                             |         | <b>7,199</b>                 | <b>\$29,374</b>         | <b>\$104,242</b>      | <b>3.36</b>              | <b>3.47</b> |
| <b>GROUP 4 FUNDING CATEGORY: OSD PIF</b>          |         |                              |                         |                       |                          |             |

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP | ECO | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR |
|---------------|-----|------------------------------|-------------------------|-----------------------|--------------------------|-----|
|---------------|-----|------------------------------|-------------------------|-----------------------|--------------------------|-----|

| GROUP 5<br>Building 475 Repairs |                            |         |       |         |          |      |      |
|---------------------------------|----------------------------|---------|-------|---------|----------|------|------|
| 475                             | Attic Insulation - Rotunda | ECO-A3  | 142   | \$578   | \$4,868  | 7.96 | 2.03 |
| 475                             | Exhaust Heat Recovery      | ECO-M5  | 453   | \$2,130 | \$12,909 | 6.66 | 1.76 |
| 475C                            | Air System Repair          | ECO-M11 | 273   | \$1,458 | \$1,779  | 1.51 | 7.72 |
| 475D                            | Air System Repair          | ECO-M11 | 277   | \$1,474 | \$1,779  | 1.49 | 7.83 |
| 475F                            | Air System Repair          | ECO-M11 | 307   | \$1,641 | \$1,779  | 1.34 | 8.68 |
| 475G                            | Air System Repair          | ECO-M11 | 247   | \$1,323 | \$1,779  | 1.67 | 6.99 |
| 475A                            | Lighting Levels - Chapel   | ECO-E1  | 3     | \$43    | \$213    | 4.70 | 2.40 |
| 475B                            | Lighting Levels            | ECO-E1  | 3     | \$40    | \$213    | 5.00 | 2.20 |
| 475H                            | Lighting Levels            | ECO-E1  | 2     | \$21    | \$213    | 9.50 | 1.20 |
| 475A                            | Energy Efficient Lighting  | ECO-E2  | 8     | \$100   | \$131    | 1.24 | 9.00 |
| GROUP 5 TOTALS                  |                            |         | 1,715 | \$8,808 | \$25,663 | 3.40 | 3.41 |
| GROUP 5 FUNDING CATEGORY: PECIP |                            |         |       |         |          |      |      |

|  |  |        |    |       |         |      |      |
|--|--|--------|----|-------|---------|------|------|
|  | <b>GROUP 6</b><br>Building 450 Repairs |        |    |       |         |      |      |
| 450  | Solar Window Shading                   | ECO-A6 | 36 | \$256 | \$2,121 | 7.84 | 1.66 |
| 450  | Lighting Levels                        | ECO-E1 | 3  | \$34  | \$213   | 5.90 | 1.90 |
| GROUP 6 TOTALS                             |  |        | 39 | \$290 | \$2,334 | 7.58 | 1.27 |
| GROUP 6 FUNDING CATEGORY: LOW COST/NO COST |  |        |    |       |         |      |      |

|                                    |        |     |         |          |      |      |  |
|------------------------------------|--------|-----|---------|----------|------|------|--|
| GROUP 7<br>Energy Efficient Motors |        |     |         |          |      |      |  |
| All Buildings in the USDB          | ECO-E3 | 248 | \$3,085 | \$22,185 | 6.81 | 1.64 |  |
| GROUP 7 TOTALS                     |        | 248 | \$3,085 | \$22,185 | 6.81 | 1.64 |  |
| GROUP 7 FUNDING CATEGORY: NONE     |        |     |         |          |      |      |  |



## ENERGY AND COST SAVINGS

### TOTAL POTENTIAL ENERGY AND COST SAVINGS

|         |                           | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$/YR |
|---------|---------------------------|------------------------------|----------------------------|
| GROUP 1 | IN HOUSE LOW COST/NO COST | 270                          | \$1,253                    |
| GROUP 2 | LAUNDRY HEAT RECOVERY     | 3,871                        | \$15,742                   |
| GROUP 3 | INSULATE DOM. WATER PIPE  | 202                          | \$1,080                    |
| GROUP 4 | POWER PLANT               | 7,199                        | \$29,374                   |
| GROUP 5 | BUILDING 475 REPAIRS      | 1,715                        | \$8,808                    |
| GROUP 6 | BUILDING 450 REPAIRS      | 39                           | \$290                      |
| GROUP 7 | ENERGY EFFICIENT MOTORS   | 248                          | \$3,085                    |
| TOTAL   |                           | 13,544                       | \$59,632                   |

### PERCENTAGE OF ENERGY CONSERVED

|                                   |        |
|-----------------------------------|--------|
| POTENTIAL ENERGY SAVINGS, MBTU    | 13,544 |
| EXISTING ENERGY CONSUMPTION, MBTU | 55,894 |
| PERCENT ENERGY CONSERVED          | 24.2%  |

### ENERGY USE AND COST

|                           | ENERGY<br>MBTU/YR | ENERGY<br>\$/YR |
|---------------------------|-------------------|-----------------|
| BEFORE ECO IMPLEMENTATION | 55,894            | \$323,459       |
| AFTER ECO IMPLEMENTATION  | 42,350            | \$263,827       |

## **GROUP 1**

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                               |   | ECO     | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR  |
|---|---|---------|------------------------------|-------------------------|-----------------------|--------------------------|------|
| <b>GROUP 1</b><br>In House Low Cost No Cost |   |         |                              |                         |                       |                          |      |
| 470   | Building 470                            | ECO-A4  | 17                           | \$69                    | \$922                 | 12.65                    | 1.28 |
| 464   | Building 464                            | ECO-A3  | 106                          | \$583                   | \$3,408               | 5.54                     | 2.57 |
| 475   | Building 475                            | ECO-M26 | 23                           | \$92                    | \$0                   |                          |      |
|   | Buildings 475C, 475D,<br>475F, and 475G | ECO-M26 | 51                           | \$210                   | \$0                   |                          |      |
|   | Tunnels                                 | ECO-M26 | 73                           | \$299                   | \$0                   |                          |      |
| GROUP 1 TOTALS                              |   |         | 270                          | \$1,253                 | \$4,330               | 6.09                     | 1.75 |
| GROUP 1 FUNDING CATEGORY: LOW COST/NO COST  |   |         |                              |                         |                       |                          |      |

**ECO-A4**

**DOCK DOOR REPLACEMENT**

# ENERGY ANALYSIS WORKSHEET

USING

ASHRAE MODIFIED BIN METHOD

| BIN<br>TEMP | AVG.<br>DB<br>TEMP | BIN<br>TEMP<br>BELOW<br>68°F | BIN<br>HOURS<br>PER<br>YEAR | EXIST Q1<br>U=1.28<br>A=64 | NEW Q2<br>U=0.17<br>A=64 | EXIST Q3<br>INFILT.<br>CFM=52.98 | NEW Q4<br>INFILT.<br>CFM=4.55 | EXIST<br>(Q1+Q3)<br>* (BIN HRS) | NEW<br>Q2+Q4<br>* (BIN HRS) |
|-------------|--------------------|------------------------------|-----------------------------|----------------------------|--------------------------|----------------------------------|-------------------------------|---------------------------------|-----------------------------|
| 100/104     | 102                |                              | 3                           |                            |                          |                                  |                               |                                 |                             |
| 95/99       | 97                 |                              | 41                          |                            |                          |                                  |                               |                                 |                             |
| 90/94       | 92                 |                              | 197                         |                            |                          |                                  |                               |                                 |                             |
| 85/89       | 87                 |                              | 436                         |                            |                          |                                  |                               |                                 |                             |
| 80/84       | 82                 |                              | 638                         |                            |                          |                                  |                               |                                 |                             |
| 75/79       | 77                 |                              | 788                         |                            |                          |                                  |                               |                                 |                             |
| 70/74       | 72                 |                              | 710                         |                            |                          |                                  |                               |                                 |                             |
| 65/69       | 67                 | 1                            | 717                         | 81.92                      | 10.88                    | 57.48                            | 4.94                          | 99952                           | 11341                       |
| 60/64       | 62                 | 6                            | 681                         | 491.52                     | 65.28                    | 344.90                           | 29.62                         | 569602                          | 64627                       |
| 55/59       | 57                 | 11                           | 587                         | 901.12                     | 119.68                   | 632.32                           | 54.30                         | 900127                          | 102129                      |
| 50/54       | 52                 | 16                           | 584                         | 1310.72                    | 174.08                   | 919.73                           | 78.99                         | 1302584                         | 147792                      |
| 45/49       | 47                 | 21                           | 539                         | 1720.32                    | 228.48                   | 1207.15                          | 103.67                        | 1577906                         | 179030                      |
| 40/44       | 42                 | 26                           | 580                         | 2129.92                    | 282.88                   | 1494.57                          | 128.36                        | 2102202                         | 238517                      |
| 35/39       | 37                 | 31                           | 678                         | 2539.52                    | 337.28                   | 1781.98                          | 153.04                        | 2929979                         | 332436                      |
| 30/34       | 32                 | 36                           | 589                         | 2949.12                    | 391.68                   | 2069.40                          | 177.72                        | 2955908                         | 335378                      |
| 25/29       | 27                 | 41                           | 347                         | 3358.72                    | 446.08                   | 2356.82                          | 202.41                        | 1983291                         | 225025                      |
| 20/24       | 22                 | 46                           | 296                         | 3768.32                    | 500.48                   | 2644.23                          | 227.09                        | 1898115                         | 215361                      |
| 15/19       | 17                 | 51                           | 153                         | 4177.92                    | 554.88                   | 2931.65                          | 251.77                        | 1087764                         | 123418                      |
| 10/14       | 12                 | 56                           | 77                          | 4587.52                    | 609.28                   | 3219.06                          | 276.46                        | 601107                          | 68202                       |
| 5/9         | 7                  | 61                           | 67                          | 4997.12                    | 663.68                   | 3506.48                          | 301.14                        | 569741                          | 64643                       |
| 0/4         | 2                  | 66                           | 47                          | 5406.72                    | 718.08                   | 3793.90                          | 325.83                        | 432429                          | 49064                       |

TOTAL EXISTING YEARLY LOAD IN BTU'S 19,010,707  
TOTAL NEW YEARLY LOAD IN BTU'S 2,156,962  
TOTAL YEARLY LOAD DIFFERENCE IN BTU'S 16,853,745

Table A4.1

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

DISCRETE PORTION NAME: 470A4  
ECONOMIC LIFE 25 YEARS

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

PREPARED BY: CRB

|                                     |     |      |
|-------------------------------------|-----|------|
| 1. INVESTMENT                       |     |      |
| A. CONSTRUCTION COST                | \$  | 870. |
| B. SIOH                             | \$  | 52.  |
| C. DESIGN COST                      | \$  | 48.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 873. |
| E. SALVAGE VALUE COST               | -\$ | 0.   |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 873. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 11.16                 | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 17.                   | \$ 69.                  | 16.15                 | 1114.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 17.                   | \$ 69.                  |                       | \$ 1114.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |      |
|---|-------|------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.   |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.   |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.   |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |      |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 368. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |      |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |       |      |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |      |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |      |

|  |       |       |
|--|-------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$    | 69.   |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$    | 1114. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 1.28  |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |       |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 12.65 |       |

ENG. FORM 150  
1AVC-59

**ECO-A3**

**ATTIC INSULATION**



## ECO-A3 ECONOMIC ANALYSIS

| BUILDING<br>NUMBER | STEAM CONSUMPTION          |                            |                             | ELECTRIC CONSUMPTION |                        |                             | TOTAL<br>SAVINGS<br>(\$) |
|--------------------|----------------------------|----------------------------|-----------------------------|----------------------|------------------------|-----------------------------|--------------------------|
|                    | BASE<br>ENERGY<br>(THERMS) | ECO-A3<br>LOAD<br>(THERMS) | ENERGY<br>SAVINGS<br>(MBTU) | BASE<br>LOAD<br>(KW) | ECO-A3<br>LOAD<br>(KW) | ENERGY<br>SAVINGS<br>(MBTU) |                          |
| 463                | 1,577                      | 1,379                      | 20                          | 83,903               | 82,814                 | 4                           | \$127                    |
| 464                | 2,195                      | 1,311                      | 88                          | 91,802               | 86,441                 | 18                          | \$588                    |
| 472                | 15,515                     | 15,241                     | 27                          | 234,490              | 232,543                | 7                           | \$194                    |
| 475                | 13,619                     | 12,203                     | 142                         | 58,399               | 58,386                 | 0                           | \$578                    |
| 475E               | 21,657                     | 21,253                     | 40                          | 611,712              | 611,617                | 0                           | \$169                    |
|                    |                            |                            |                             |                      |                        |                             | \$1,657                  |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

DISCRETE PORTION NAME: 464A3  
ECONOMIC LIFE 25 YEARS

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

PREPARED BY: CRB

|                                     |     |       |
|-------------------------------------|-----|-------|
| 1. INVESTMENT                       |     |       |
| A. CONSTRUCTION COST                | \$  | 3215. |
| B. SIOH                             | \$  | 193.  |
| C. DESIGN COST                      | \$  | 177.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 3227. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 3227. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 18.                   | \$ 224.                 | 11.16                 | 2500.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 88.                   | \$ 359.                 | 16.15                 | 5798.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 106.                  | \$ 583.                 |                       | \$ 8298.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |       |
|---|-------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 2738. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)=                    |       |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |       |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 583.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 8298. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 2.57 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 5.54 |       |

ENG. FORM 150  
1AVC-59

**ECO-M26**

**REDUCE HOT WATER  
TEMPERATURE**

|   |  |  |            |         |
|---|--|--|------------|---------|
| <b>CALCULATION SHEET</b>                          |  | DATE<br>Mar-90   | SHEET<br>1 | OF<br>5 |
| PROJECT USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |            |         |
| LOCATION  |  |  |            |         |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP   |  | <b>COMPUTED BY</b><br>RGB  |            |         |
| ECO MEASURE<br>ECO-M26                            |  |  |            |         |

TEST DATA, BTUH LOSS PER LINEAL FOOT  
 REF: Guidelines for Saving Energy in Existing Buildings  
 Federal Energy Administration Office of Energy Conservation and Environment

Tables were developed from fig. 44 of the Guidelines for Saving Energy in Existing Buildings

Ambient Temperature 68° F  
 BTUH Loss per lineal foot of bare pipe

Bare Pipe

| Pipe Size | 180° Water | 160° Water | 140° Water | 120° Water |
|-----------|------------|------------|------------|------------|
| 3/4"      | 85         | 70         | 55         | 39         |
| 1"        | 105        | 85         | 66         | 46         |
| 1-1/4"    | 126        | 104        | 81         | 57         |
| 1-1/2"    | 150        | 121        | 95         | 67         |
| 2"        | 171        | 140        | 110        | 80         |
| 2-1/2"    | 205        | 169        | 133        | 94         |
|           |            |            |            |            |

Table M26-1a

Ambient Temperature 68° F  
 BTUH Loss per lineal foot of insulated pipe

1/2" Fiberglass Insulation

| Pipe Size | 180° Water | 160° Water | 140° Water | 120° Water |
|-----------|------------|------------|------------|------------|
| 3/4"      | 20         | 15         | 11         | 8          |
| 1"        | 21         | 17         | 12         | 9          |
| 1-1/4"    | 26         | 20         | 16         | 11         |
| 1-1/2"    | 30         | 24         | 19         | 13         |
| 2"        | 36         | 30         | 23         | 15         |
| 2-1/2"    | 45         | 35         | 27         | 20         |
|           |            |            |            |            |

Table M26-1b

|   |  |   |            |         |
|---|--|---|------------|---------|
| <b>CALCULATION SHEET</b>                          |  | DATE<br>Mar-90  | SHEET<br>2 | OF<br>5 |
| PROJECT USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  | BASIS FOR CALCULATION<br><br><input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |            |         |
| LOCATION  |  |   |            |         |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP   |  | COMPUTED BY<br>RGB  |            |         |
| ECO MEASURE<br>ECO-M26                            |  |   |            |         |

TEST DATA, BTUH LOSS PER LINEAL FOOT  
 REF: Guidelines for Saving Energy in Existing Buildings  
 Federal Energy Administration Office of Energy Conservation and Environment

Tables were developed from fig. 44 of the Guidelines for Saving Energy in Existing Buildings

Ambient Temperature 68° F  
 BTUH Loss per lineal foot of bare pipe

**Bare Pipe**

| Pipe Size | Btuh loss @ 180° | Btuh loss @ 140° | Btuh Savings | Hours per Year | \$ Savings per L.F. |
|-----------|------------------|------------------|--------------|----------------|---------------------|
| 3/4"      | 85               | 55               | 30           | 4380           | \$0.70              |
| 1"        | 105              | 66               | 39           | 4380           | \$0.91              |
| 1-1/4"    | 126              | 81               | 45           | 4380           | \$1.05              |
| 1-1/2"    | 150              | 95               | 55           | 4380           | \$1.29              |
| 2"        | 171              | 110              | 61           | 4380           | \$1.43              |
| 2-1/2"    | 205              | 133              | 72           | 4380           | \$1.68              |
|           |                  |                  |              |                |                     |

Table M26-2a

Ambient Temperature 68° F  
 BTUH Loss per lineal foot of insulated pipe

**1/2" Fiberglass Insulation**

| Pipe Size | Btuh loss @ 180° | Btuh loss @ 140° | Btuh Savings | Hours per Year | \$ Savings per L.F. |
|-----------|------------------|------------------|--------------|----------------|---------------------|
| 3/4"      | 20               | 15               | 5            | 4380           | \$0.12              |
| 1"        | 22               | 17               | 5            | 4380           | \$0.12              |
| 1-1/4"    | 26               | 20               | 6            | 4380           | \$0.14              |
| 1-1/2"    | 30               | 24               | 6            | 4380           | \$0.14              |
| 2"        | 36               | 30               | 6            | 4380           | \$0.14              |
| 2-1/2"    | 45               | 35               | 10           | 4380           | \$0.23              |
|           |                  |                  |              |                |                     |

Table M26-2b

|   |  |   |                          |
|---|--|---|--------------------------|
| <b>CALCULATION SHEET</b>                                    |  | <b>DATE</b><br>Mar-90   | <b>SHEET OF</b><br>3 5   |
| <b>PROJECT</b><br>USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  | <b>BASIS FOR CALCULATION</b><br><br>X <input type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |                          |
| <b>LOCATION</b>   |  |   |                          |
| <b>ARCHITECT/ENGINEER</b><br>CLARK RICHARDSON & BISKUP      |  |   |                          |
| <b>ECO MEASURE</b><br>ECO-M26                               |  | <b>COMPUTED BY</b><br>RGB   | <b>CHECKED BY</b><br>MAW |

# REDUCED DOMESTIC HOT WATER TEMPERATURE

$$T_m = (Q_1 \cdot T_1) + (Q_2 \cdot T_2) / (Q_1 + Q_2)$$

T<sub>m</sub> = mixed water temperature

T<sub>1</sub> = temperature of fl (Cold Water Temp.)

Assumption:

T<sub>m</sub> = 110

T<sub>1</sub> = 40°

T<sub>2</sub> = X

| T <sub>m</sub> (°) | T <sub>1</sub> (°) | Q <sub>1</sub> (Gal.) | T <sub>2</sub> (°) | Q <sub>2</sub> (Gal.) |
|--------------------|--------------------|-----------------------|--------------------|-----------------------|
| 110.00             | 40.00              | 68.18                 | 180.00             | 31.82                 |
| 110.00             | 40.00              | 66.67                 | 170.00             | 33.33                 |
| 110.00             | 40.00              | 65.00                 | 160.00             | 35.00                 |
| 110.00             | 40.00              | 63.16                 | 150.00             | 36.84                 |
| 110.00             | 40.00              | 61.11                 | 140.00             | 38.89                 |
| 110.00             | 40.00              | 58.82                 | 130.00             | 41.18                 |
| 110.00             | 40.00              | 56.25                 | 120.00             | 43.75                 |

Table M26-3

|   |  |  |                          |
|---|--|--|--------------------------|
| <b>CALCULATION SHEET</b>                                    |  | <b>DATE</b><br>Mar-90  | <b>SHEET OF</b><br>5- 5  |
| <b>PROJECT</b><br>USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  | <b>BASIS FOR CALCULATION</b>   |                          |
| <b>LOCATION</b>   |  | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |
| <b>ARCHITECT/ENGINEER</b><br>CLARK RICHARDSON & BISKUP      |  |  |                          |
| <b>ECO MEASURE</b><br>ECO-M26                               |  | <b>COMPUTED BY</b><br>RGB  | <b>CHECKED BY</b><br>MAW |

TEST DATA, BTUH LOSS PER LINEAL FOOT  
 REF: Guidelines for Saving Energy in Existing Buildings  
 Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b  
 Length of pipe estimated from field inspection and plans.

**Building 475E**

| Pipe Size | Feet of Bare Pipe | \$ Savings per Ft. | Feet of Insulated | \$ Savings per FT. |  | \$ Savings Year |
|-----------|-------------------|--------------------|-------------------|--------------------|--|-----------------|
| 3/4"      |                   | \$0.70             |                   | \$0.12             |  | \$0             |
| 1"        |                   | \$0.91             |                   | \$0.12             |  | \$0             |
| 1-1/4"    | 100               | \$1.05             |                   | \$0.14             |  | \$105           |
| 1-1/2"    | 20                | \$1.29             | 20                | \$0.14             |  | \$29            |
| 2"        |                   | \$1.29             |                   | \$0.14             |  | \$0             |
|           |                   |                    |                   |                    |  |                 |

Energy Savings = **\$134.00**

**Tunnels between building 468, 466, 467, 463, 464, 472, 473**

| Pipe Size | Feet of Bare Pipe | \$ Savings per Ft. | Feet of Insulated | \$ Savings per FT. |  | \$ Savings Year |
|-----------|-------------------|--------------------|-------------------|--------------------|--|-----------------|
| 3/4"      |                   | \$0.70             |                   | \$0.23             |  | \$0             |
| 1"        |                   | \$0.91             | 180               | \$0.23             |  | \$41            |
| 1-1/4"    | 60                | \$1.05             | 90                | \$0.28             |  | \$88            |
| 1-1/2"    | 55                | \$1.29             | 355               | \$0.28             |  | \$170           |
| 2"        |                   | \$1.29             |                   | \$0.28             |  | \$0             |
|           |                   |                    |                   |                    |  |                 |

Energy Savings = **\$299.00**



|                           |   |  |                          |
|---------------------------|---|--|--------------------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET OF</b><br>4 5   |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b>   |                          |
| <b>LOCATION</b>           |   | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 | <b>COMPUTED BY</b><br>RGB  | <b>CHECKED BY</b><br>MAW |
| <b>ECO MEASURE</b>        | ECO-M26                                   |  |                          |

TEST DATA, BTUH LOSS PER LINEAL FOOT  
 REF: Guidelines for Saving Energy in Existing Buildings  
 Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b  
 Length of pipe estimated from field inspection and plans.

**Building 475**

| Pipe Size | Feet of Bare Pipe | \$ Savings per Ft. | Feet of Insulated | \$ Savings per FT. |  | \$ Savings Year |
|-----------|-------------------|--------------------|-------------------|--------------------|--|-----------------|
| 3/4"      |                   | \$0.70             |                   | \$0.12             |  | \$0             |
| 1"        |                   | \$0.91             |                   | \$0.12             |  | \$0             |
| 1-1/4"    | 60                | \$1.05             |                   | \$0.14             |  | \$63            |
| 1-1/2"    | 20                | \$1.29             | 20                | \$0.14             |  | \$29            |
| 2"        |                   | \$1.29             |                   | \$0.14             |  | \$0             |
|           |                   |                    |                   |                    |  |                 |

Energy Savings = \$92.00

**Buildings 475C, 475D, 475F, 475G**

| Pipe Size | Feet of Bare Pipe | \$ Savings per Ft. | Feet of Insulated | \$ Savings per FT. |  | \$ Savings Year |
|-----------|-------------------|--------------------|-------------------|--------------------|--|-----------------|
| 3/4"      |                   | \$0.70             |                   | \$0.23             |  | \$0             |
| 1"        |                   | \$0.91             |                   | \$0.23             |  | \$0             |
| 1-1/4"    | 200               | \$1.05             | 0                 | \$0.28             |  | \$210           |
| 1-1/2"    |                   | \$1.29             |                   | \$0.28             |  | \$0             |
| 2"        |                   | \$1.29             |                   | \$0.28             |  | \$0             |
|           |                   |                    |                   |                    |  |                 |

Energy Savings = \$210.00

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 12-5-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: GROUP #1  
 ECONOMIC LIFE 15 YEARS  
 PREPARED BY: CRB

1. INVESTMENT

|                                     |     |       |
|-------------------------------------|-----|-------|
| A. CONSTRUCTION COST                | \$  | 4085. |
| B. SIOH                             | \$  | 245.  |
| C. DESIGN COST                      | \$  | 225.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 4100. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 4100. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 18.                   | \$ 224.                 | 8.69                  | 1947.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 110.                  | \$ 449.                 | 11.67                 | 5240.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 128.                  | \$ 673.                 |                       | \$ 7187.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |       |
|---|------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 2372. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F)=                    |      |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |       |

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 673.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 7187.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.75  
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 6.09

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

|               |      |   |                   |  |  |
|---------------|------|---|-------------------|--|--|
| FORM 1 AUG 78 | 4283 | EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED. | GROUP 1 - PAGE 14 | WHITE (ORIGINAL) - PROJECT FILE COPY<br>PINK - FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL ACTION" BLOCK | GREEN - FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FOR APPROVAL" BLOCK |
|---------------|------|---|-------------------|--|--|

## **GROUP 2**

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                   |                          | ECO     | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR  |
|---------------------------------|--------------------------|---------|------------------------------|-------------------------|-----------------------|--------------------------|------|
| 474                             | <b>GROUP 2</b>           |         |                              |                         |                       |                          |      |
|                                 | Laundry Heat Recovery    |         |                              |                         |                       |                          |      |
|                                 | Wash Water Heat Recovery | ECO-M31 | 3,871                        | \$15,742                | \$46,459              | 2.79                     | 4.18 |
|                                 | GROUP 2 TOTALS           |         | 3,871                        | \$15,742                | \$46,459              | 2.79                     | 4.18 |
| GROUP 2 FUNDING CATEGORY: PECIP |                          |         |                              |                         |                       |                          |      |

# **ECO-M31**

**HEAT RECOVERY FOR  
LAUNDRY**

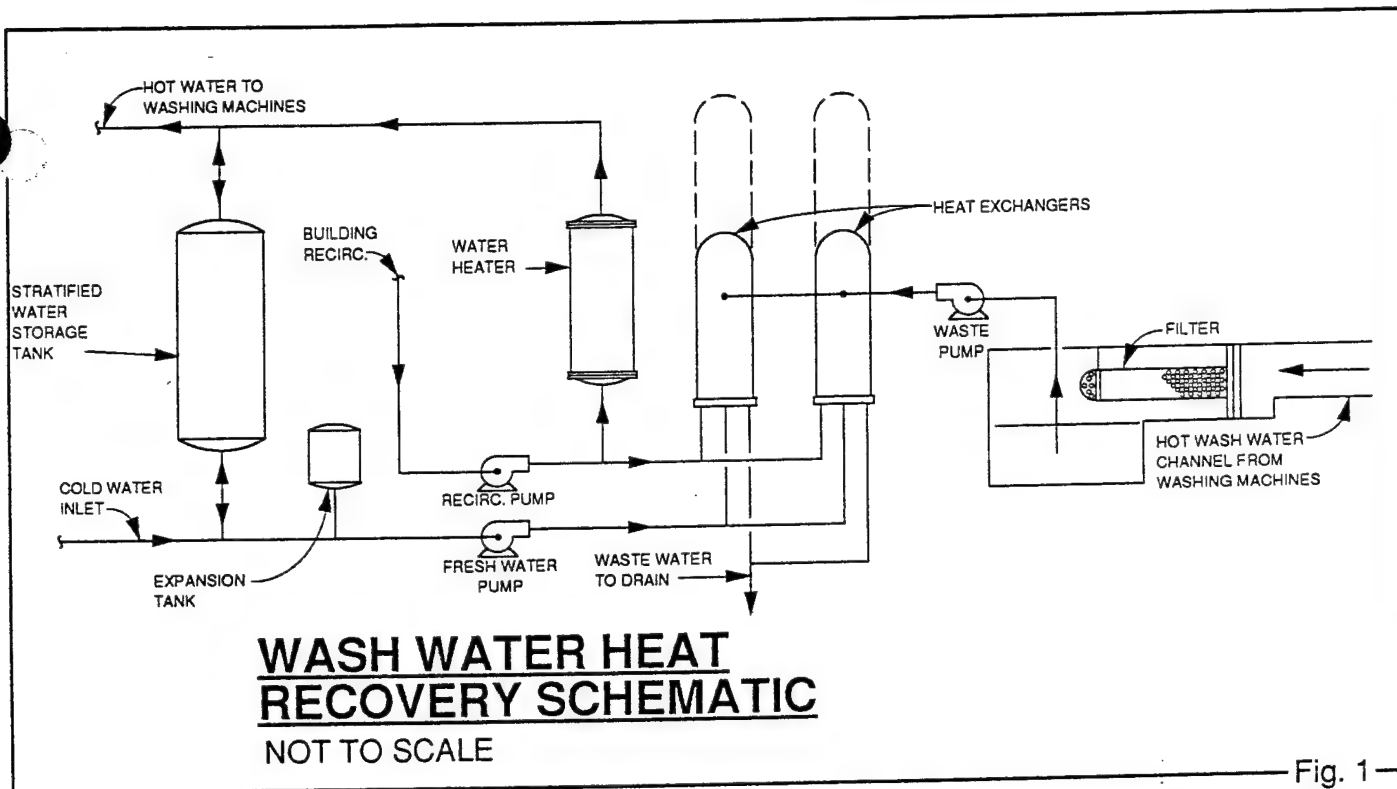


Fig. 1

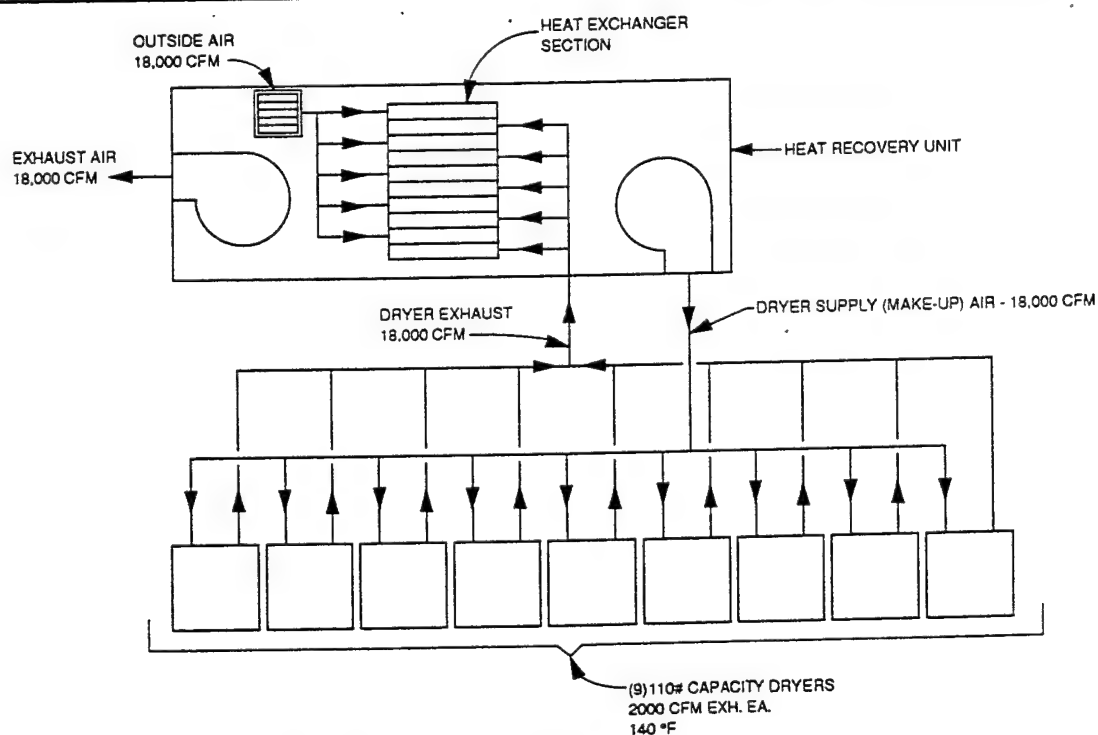


Fig. 2

|                           |   |  |                          |                |
|---------------------------|---|--|--------------------------|----------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET</b><br>1        | <b>OF</b><br>1 |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                |
| <b>LOCATION</b>           | FORT LEAVENWORTH, KANSAS                  |  |                          |                |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 |  |                          |                |
| <b>ECO MEASURE</b>        | ECO-M31 WASH WATER HEAT RECOVERY          | <b>COMPUTED BY</b><br>BMS  | <b>CHECKED BY</b><br>MAW |                |

GIVEN:

|  |       |
|--|-------|
| HOT WATER USE TEMP., °F                  | 160   |
| AVERAGE COLD WATER INLET TEMPERATURE, °F | 50    |
| GALLONS WATER/LB. OF LAUNDRY             | 2.5   |
| PERCENT OF WASTE WATER THAT IS HOT       | 70    |
| HOURS OF OPERATION PER WEEK              | 40    |
| ELECTRICITY COST, DOLLARS/MBTU           | 12.44 |
| GAS COST IN DOLLARS/MBTU                 | 4.08  |
| BOILER SEASONAL EFFICIENCY, %            | 74    |

|                                       |     |
|---------------------------------------|-----|
| CALCULATED WASTE WATER TEMP., °F      | 127 |
| WASTE WATER TEMP USED IN ANALYSIS, °F | 124 |

BASED ON HEAT EXCHANGER MANUFACTURER'S  
PERFORMANCE DATA FOR 30 GPM UNIT:

|                                   |          |
|-----------------------------------|----------|
| SHELL SIDE TEMPERATURE, °F IN/OUT | 124 / 91 |
| TUBE SIDE TEMPERATURE, °F IN/OUT  | 50 / 96  |

|                                |       |
|--------------------------------|-------|
| STEAM HEAT RECOVERED, MBTU/YR: | 2,870 |
| GAS HEAT RECOVERED, MBTU/YR:   | 3,878 |

(2) 30 GPM UNITS ARE REQUIRED.

PUMP ENERGY CALCULATION FOR THIS ECO

|  |      |
|--|------|
| FRESH WATER PUMP CAPACITY, GPM:            | 60   |
| FRESH WATER PUMP HEAD, FT. W:              | 38   |
| FRESH WATER PUMP EFFICIENCY, %:            | 65   |
| WASTE WATER PUMP CAPACITY, GPM:            | 84   |
| WASTE WATER PUMP HEAD, FT. W:              | 10   |
| WASTE WATER PUMP EFFICIENCY, %:            | 65   |
| FRESH WATER PUMP POWER CONSUMPTION, WATTS: | 662  |
| FRESH WATER PUMP ENERGY USE, MBTU/YEAR:    | 4.70 |
| WASTE WATER PUMP POWER CONSUMPTION, WATTS: | 244  |
| WASTE WATER PUMP ENERGY USE, MBTU/YEAR:    | 1.73 |
| TOTAL PUMP ENERGY, MBTU/YR.:               | 6.43 |

NET ENERGY SAVINGS FOR WASH WATER H.R., MBTU/YR.: 3,872

NET ENERGY SAVINGS, \$/YR: 15,742



LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-27-90

DISCRETE PORTION NAME: ECOM31W  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

1. INVESTMENT

|                                     |           |
|-------------------------------------|-----------|
| A. CONSTRUCTION COST                | \$ 43829. |
| B. SIOH                             | \$ 2630.  |
| C. DESIGN COST                      | \$ 2411.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$ 43983. |
| E. SALVAGE VALUE COST               | -\$ 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$ 43983. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | -6.                   | \$ -75.                 | 8.69                  | -652.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 3878.                 | \$ 15822.               | 11.67                 | 184643.                  |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 3872.                 | \$ 15747.               |                       | \$ 183991.               |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |           |
|---|-----------|
| A. ANNUAL RECURRING (+/-)                                     | \$ 0.     |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$ 0.     |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$ 0.     |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |           |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$ 60717. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |           |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     | _____     |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |           |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |           |

|  |            |
|--|------------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$ 15747.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$ 183991. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 4.18       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |            |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.79       |

|   |           |                  |          |  |          |               |            |
|---|-----------|------------------|----------|--|----------|---------------|------------|
| <b>CONSTRUCTION COST ESTIMATE</b>               |           |                  |          | DATE PREPARED<br>4/2/90  |          | SHEET OF<br>1 |            |
| PROJECT<br>USDB ENERGY STUDY                    |           |                  |          | BASIS FOR ESTIMATE<br><br><input checked="" type="checkbox"/> <b>CODE A (NO DESIGN COMPLETED)</b><br><input type="checkbox"/> <b>CODE B (PRELIMINARY DESIGN)</b><br><input type="checkbox"/> <b>CODE C (FINAL DESIGN)</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |          |               |            |
| LOCATION<br>FORT LEAVENWORTH, KS                |           |                  |          |  |          |               |            |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP |           |                  |          |  |          |               |            |
| DRAWING NO.<br>NONE                             |           | ESTIMATOR<br>BMS |          | CHECKED BY<br>MAW  |          |               |            |
| ECO-M31   | QUANTITY  |                  | MATERIAL |  | LABOR    |               | TOTAL COST |
|   | NO. UNITS | UNIT MEAS.       | PER UNIT | TOTAL  | PER UNIT | TOTAL         |            |
| WASH WATER HEAT RECOVERY SYSTEM                 |           |                  |          |  |          |               |            |
| HELICAL COIL HEAT EXCHANGER                     | 2         | EA               | \$9,500  | \$19,000   | \$1,010  | \$2,020       | \$21,020   |
| FRESH WATER PUMP (59 GPM, 50 FT. HD.)           | 1         | EA               | \$1,070  | \$1,070  | \$180    | \$180         | \$1,250    |
| WASTE WATER PUMP (94 GPM, 10 FT. HD.)           | 1         | EA               | \$500    | \$500  | \$40     | \$40          | \$540      |
| STRATIFIED WATER STORAGE TANK                   | 1         | EA               | \$6,500  | \$6,500  | \$355    | \$355         | \$6,855    |
| 2" SCHEDULE 40 STEEL PIPING & ACCESSORIES       | 100       | LF               | \$3      | \$289  | \$6      | \$555         | \$844      |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
|   |           |                  |          |  |          |               |            |
| SUBTOTAL  |           |                  |          | \$27,359   |          | \$3,150       | \$30,509   |
| CONTINGENCY 10%                                 |           |                  | 10%      | \$2,736  | 10%      | \$315         | \$3,051    |
| SUBTOTAL  |           |                  |          | \$30,095   |          | \$3,465       | \$33,560   |
| WORK COMP, TAX, SOC. SEC., INS                  |           |                  | 3.50%    | \$1,053  | 13.0%    | \$450         | \$1,503    |
| DIRECT COST                                     |           |                  |          | \$31,148   |          | \$3,915       | \$35,063   |
| OVERHEAD AND PROFIT                             |           |                  | 25%      | \$7,787  | 25%      | \$979         | \$8,766    |
| SUBTOTAL  |           |                  |          | \$38,935   |          | \$4,894       | \$43,829   |
| CONSTRUCTION COST                               |           |                  |          |  |          |               | \$43,829   |

ENG. FORM 150  
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-27-90

DISCRETE PORTION NAME: GROUP #2  
ECONOMIC LIFE 15 YEARS

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

PREPARED BY: CRB

|                                     |     |        |
|-------------------------------------|-----|--------|
| 1. INVESTMENT                       |     |        |
| A. CONSTRUCTION COST                | \$  | 43829. |
| B. SIOH                             | \$  | 2630.  |
| C. DESIGN COST                      | \$  | 2411.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 43983. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 43983. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | -6.                   | \$ -75.                 | 8.69                  | -652.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 3878.                 | \$ 15822.               | 11.67                 | 184643.                  |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 3872.                 | \$ 15747.               |                       | \$ 183991.               |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |           |    |    |
|---|-----------|----|----|
| A. ANNUAL RECURRING (+/-)                                     |           | \$ | 0. |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11      |    |    |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |           | \$ | 0. |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |           | \$ | 0. |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |           |    |    |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$ 60717. |    |    |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |           |    |    |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |           |    |    |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |           |    |    |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |           |    |    |

|  |      |         |
|--|------|---------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 15747.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 183991. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 4.18 |         |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |         |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.79 |         |

## FACILITIES ENGINEERING WORK REQUEST - XFA, XFB, XFC

[illegible]

ION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

about a counterflow, helical coil heat exchanger in building 474, the present location of the USDB laundry facility. Hot, dirty washwater from each heat could be recovered for preheat of fresh washwater is currently being wasted to drain.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

If this heat recovery unit is not installed, approximately 3,878 million BTU's per year from wastewater will continue to be wasted.

| REQUESTER INFORMATION |               | PERSON TO CALL FOR ADDITIONAL INFORMATION |              | TELEPHONE N |
|-----------------------|---------------|---|--------------|-------------|
| ORGANIZATION          | TELEPHONE NO. | NAME                                      | ORGANIZATION |             |
|                       |               |   |              |             |

| FORWARD FOR APPROVAL  |  |                   |                                    | FROM                |  |
|---|--|-------------------|------------------------------------|---------------------|--|
| RECOMMENDED ACTION  | ENVIRONMENTAL IMPACT                               | ESTIMATED COST    | WORK TO BE PERFORMED               | FACILITIES ENGINEER |  |
| <input type="checkbox"/> APPROVAL<br><input type="checkbox"/> DISAPPROVAL | NO YES   | FUNDED \$         | <input type="checkbox"/> IN-HOUSE  | DATE _____<br>_____ |  |
|   | <input checked="" type="checkbox"/> CONSIDERATIONS | WC X 46,459       | <input type="checkbox"/> SELF-HELP |                     |  |
|   | <input type="checkbox"/> EIS/EIA                   | WC L              | <input type="checkbox"/> CONTRACT  |                     |  |
|   | <input checked="" type="checkbox"/> INITIATED      | WC —              | <input type="checkbox"/> TROOP     |                     |  |
|   | <input type="checkbox"/> EIS/EIA                   | UNFUNDED \$ 2,112 |                                    |                     |  |
|   | <input checked="" type="checkbox"/> COMPLETED      | TOTAL \$ 48,571   |                                    |                     |  |
| C AUTHORITY   |  |                   |                                    |                     |  |

|                     |  |
|---------------------|--|
| APPROVED FOR DESIGN | SOURCE OF FUNDS  |
| SIGNATURE           | <input type="checkbox"/> DIRECT<br><input type="checkbox"/> AUTOMATIC REIMB.<br><input type="checkbox"/> FUNDED REIMB. |
| DATE                |  |
| REMARKS             |  |

|                                 |    |    |    |              |    |              |    |    |  |
|---------------------------------|----|----|----|--------------|----|--------------|----|----|--|
| APPROVAL ACTION                 |    |    |    |              |    |              |    |    |  |
| DOCUMENT NUMBER                 |    |    |    | ACTION TAKEN |    | DATE         |    |    |  |
| SERIAL NUMBER                   |    | FY |    |              |    | MO           |    | OA |  |
| 16                              | 7  | 8  | 9  | 10           | 11 | 12           | 13 | 14 |  |
| A - APPROVED<br>O - DISAPPROVED |    |    |    |              |    |              |    |    |  |
| SIGNATURE OF APPROVAL AUTHORITY |    |    |    |              |    |              |    |    |  |
| DESIGN                          |    |    |    | ESTIMATOR    |    | FORWARDED TO |    |    |  |
| MO                              |    | OA |    | MO           |    | OA           |    |    |  |
| 19                              | 20 | 21 | 22 | 23           | 24 | 25           | 26 |    |  |

## **GROUP 3**

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                                     |   | ECO | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR  |
|---|---|-----|------------------------------|-------------------------|-----------------------|--------------------------|------|
| 475   | <b>GROUP 3</b><br>Insulate Water Piping |     |                              |                         |                       |                          |      |
|   | Castle Building                         | M30 | 147                          | 787                     | \$1,447               | 2.28                     | 5.11 |
|   | Pipe Tunnels                            | M30 | 55                           | 293                     | \$481                 | 2.03                     | 5.75 |
|   | <b>GROUP 3 TOTALS</b>                   |     | 202                          | \$1,080                 | \$1,928               | 2.21                     | 5.27 |
| <b>GROUP 3 FUNDING CATEGORY: LOW COST/NO COST</b> |   |     |                              |                         |                       |                          |      |

**ECO-M30**

**DOMESTIC WATER PIPE  
INSULATION**

|                           |   |  |                          |
|---------------------------|---|--|--------------------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET</b> 0F<br>1 2   |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |
| <b>LOCATION</b>           |   |  |                          |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 |  |                          |
| <b>ECO MEASURE</b>        | ECO-M30                                   | <b>COMPUTED BY</b><br>RGB  | <b>CHECKED BY</b><br>MAW |

TEST DATA, BTUH LOSS PER LINEAL FOOT  
 REF: Guidelines for Saving Energy in Existing Buildings  
 Federal Energy Administration Office of Energy Conservation and Environment

Table was developed from fig. 44 of the Guidelines for Saving Energy in Existing Buildings

Ambient Temperature 68° F  
 Domestic Hot Water Temperature 180°

| Pipe Size | BTUH Loss Bare Pipe | BTUH Loss Insulated | BTUH Savings | Hours per Year | \$ Savings per L.F. |
|-----------|---------------------|---------------------|--------------|----------------|---------------------|
| 3/4"      | 85                  | 19                  | 66           | 4380           | \$1.54              |
| 1"        | 105                 | 23                  | 82           | 4380           | \$1.92              |
| 1-1/4"    | 126                 | 26                  | 100          | 4380           | \$2.34              |
| 1-1/2"    | 150                 | 31                  | 119          | 4380           | \$2.78              |
| 2"        | 171                 | 37                  | 134          | 4380           | \$3.13              |
| 2-1/2"    | 250                 | 45                  | 205          | 4380           | \$4.79              |
|           |                     |                     |              |                |                     |



|                           |   |  |                          |
|---------------------------|---|--|--------------------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET OF</b><br>2 2   |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b>   |                          |
| <b>LOCATION</b>           |   | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 | <b>COMPUTED BY</b><br>RGB  | <b>CHECKED BY</b><br>MAW |
| <b>ECO MEASURE</b>        | ECO-M30                                   |  |                          |

TEST DATA, BTUH LOSS PER LINEAL FOOT  
 REF: Guidelines for Saving Energy in Existing Buildings  
 Federal Energy Administration Office of Energy Conservation and Environment

Tables derived from Tables M26-2a and M26-2b  
 Length of pipe estimated from field inspection and plans.

Castle Buildings

| Pipe Size | Feet of Bare Pipe | \$ Savings per Ft. | \$ Savings Year |
|-----------|-------------------|--------------------|-----------------|
| 3/4"      | 80                | \$1.54             | \$123           |
| 1"        |                   | \$1.92             | \$0             |
| 1-1/4"    | 260               | \$2.34             | \$608           |
| 1-1/2"    | 20                | \$2.78             | \$56            |
| 2"        |                   | \$3.13             | \$0             |
|           |                   |                    |                 |

Energy Savings = **\$787.00**

Pipe Tunnels

| Pipe Size | Feet of Bare Pipe | \$ Savings per Ft. | \$ Savings Year |
|-----------|-------------------|--------------------|-----------------|
| 3/4"      |                   | \$1.54             | \$0             |
| 1"        |                   | \$1.92             | \$0             |
| 1-1/4"    | 60                | \$2.34             | \$140           |
| 1-1/2"    | 55                | \$2.78             | \$153           |
| 2"        |                   | \$3.13             | \$0             |
|           |                   |                    |                 |

Energy Savings = **\$293.00**

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

DISCRETE PORTION NAME: ECOM30CB  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

1. INVESTMENT

|                                     |     |       |
|-------------------------------------|-----|-------|
| A. CONSTRUCTION COST                | \$  | 1365. |
| B. SIOH                             | \$  | 82.   |
| C. DESIGN COST                      | \$  | 75.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 1370. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 1370. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 147.                  | \$ 600.                 | 11.67                 | 7002.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 147.                  | \$ 600.                 |                       | \$ 7002.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |       |
|---|-------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11  |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 2311. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     | _____ |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |       |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 600.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 7002. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 5.11 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.28 |       |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOM30PT  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

|                                     |    |      |
|-------------------------------------|----|------|
| 1. INVESTMENT                       |    |      |
| A. CONSTRUCTION COST                | \$ | 454. |
| B. SIOH                             | \$ | 27.  |
| C. DESIGN COST                      | \$ | 25.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$ | 455. |
| E. SALVAGE VALUE COST               | \$ | 0.   |
| F. TOTAL INVESTMENT (1D-1E)         | \$ | 455. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 55.                   | \$ 224.                 | 11.67                 | 2614.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 55.                   | \$ 224.                 |                       | \$ 2614.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |    |      |
|---|------|----|------|
| A. ANNUAL RECURRING (+/-)                                     |      | \$ | 0.   |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |    |      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |      | \$ | 0.   |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |      | \$ | 0.   |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |    |      |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       |      | \$ | 863. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |    |      |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |    |      |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |    |      |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |    |      |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 224.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 2614. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 5.75 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.03 |       |

ENG. FORM 150  
1AVC-59

ENG. FORM 150  
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 12-5-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: GROUP #3  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

|                                     |     |       |
|-------------------------------------|-----|-------|
| 1. INVESTMENT                       |     |       |
| A. CONSTRUCTION COST                | \$  | 1819. |
| B. SIOH                             | \$  | 109.  |
| C. DESIGN COST                      | \$  | 100.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 1825. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 1825. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 202.                  | \$ 824.                 | 11.67                 | 9616.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 202.                  | \$ 824.                 |                       | \$ 9616.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |    |       |
|---|------|----|-------|
| A. ANNUAL RECURRING (+/-)                                     |      | \$ | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |    |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |      | \$ | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |      | \$ | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |    |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       |      | \$ | 3173. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |    |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |    |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |    |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |    |       |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 824.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 9616. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 5.27 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.21 |       |

FACILITIES ENGINEERING WORK REQUEST - XFA, XFB, XFC

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

[illegible]

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

DESCRIPTION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

Apply insulation to existing uninsulated domestic hot water piping in USDH piping tunnels. This will result in less heat loss from the water to ambient spaces and less water waste.

Energy will continue to be wasted from the exposed piping to surrounding spaces. Currently, approximately 147 million BTU's per year is wasted from Castle domestic hot water piping, while approximately 55 million BTU's per year is wasted from pipe tunnel piping. In addition, more water will be consumed due to lower point-of-use temperatures.

| REQUESTER INFORMATION |               | PERSON TO CALL FOR ADDITIONAL INFORMATION |      | TELEPHONE NO. |
|-----------------------|---------------|---|------|---------------|
| ORGANIZATION          | TELEPHONE NO. | SIGNATURE                                 | NAME | ORGANIZATION  |
|                       |               |   |      |               |

| FORWARD FOR APPROVAL |   |   |  | APPROVED FOR DESIGN  |                                 | SOURCE OF FUNDS |      |
|----------------------|---|---|--|--|---------------------------------|-----------------|------|
| PROVING AUTHORITY    | RECOMMENDED ACTION  | ENVIRONMENTAL IMPACT  | ESTIMATED COST   | WORK TO BE PERFORMED   | FROM                            | SIGNATURE       | DATE |
|                      | <input type="checkbox"/> APPROVAL<br><input type="checkbox"/> DISAPPROVAL | NO <input checked="" type="checkbox"/> YES <input type="checkbox"/><br><input checked="" type="checkbox"/> ENVIRONMENTAL CONSIDERATIONS<br><input checked="" type="checkbox"/> EIS/EIA INITIATED<br><input checked="" type="checkbox"/> EIS/EIA COMPLETED | FUNDED \$<br>WC K \$ 1,928<br>WC L \$<br>WC UNFUNDED \$ 88<br>TOTAL \$ 2,016 | <input type="checkbox"/> IN-HOUSE<br><input type="checkbox"/> SELF-HELP<br><input type="checkbox"/> CONTRACT<br><input type="checkbox"/> TROOP | FACILITIES ENGINEER<br><br>DATE |                 |      |

[illegible]

## **GROUP 4**



**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                     |                               | ECO | ENERGY SAVINGS<br>MBTU/YR | ENERGY SAVINGS<br>\$ | PROJECT COST<br>\$ | SIMPLE PAYBACK<br>YRS | SIR  |
|-----------------------------------|-------------------------------|-----|---------------------------|----------------------|--------------------|-----------------------|------|
| <b>GROUP 4</b><br>Power Plant     |                               |     |                           |                      |                    |                       |      |
| 474                               | Outside Testing - Steam Traps | M3  | 1,510                     | \$6,161              | \$17,119           | 2.63                  | 4.44 |
| 474                               | Reduce Steam Pressure         | M12 | 605                       | \$2,470              | \$9,931            | 3.81                  | 3.06 |
| 474                               | Condensate Return System      | M14 | 1,687                     | \$6,883              | \$38,115           | 5.24                  | 2.23 |
| 474                               | Oxygen Trim Controls          | M15 | 3,397                     | \$13,860             | \$39,077           | 2.67                  | 4.37 |
| GROUP 4 TOTALS                    |                               |     | 7,199                     | \$29,374             | \$104,242          | 3.36                  | 3.47 |
| GROUP 4 FUNDING CATEGORY: OSD PIF |                               |     |                           |                      |                    |                       |      |

# **ECO-M3**

**SERVICE STEAM PIPING  
AND TRAPS**

|                          |   |  |                   |
|--------------------------|---|--|-------------------|
| <b>CALCULATION SHEET</b> |   | DATE<br>March, 1987  | SHEET 1 OF 1      |
| PROJECT                  | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |                   |
| LOCATION                 |   |  |                   |
| ARCHITECT/ENGINEER       | CLARK RICHARDSON & BISKUP                 |  |                   |
| ECO MEASURE              | STEAM TRAP PROGRAM - OWNER TESTING        | COMPUTED BY<br>TGD   | CHECKED BY<br>MAW |

**COST OF STEAM AT FORT LEAVENWORTH - USDB**

|  |                          |
|--|--------------------------|
| ENTHALPY OF WATER AT 160° F. =                       | 128 BTU/LBM              |
| ENTHALPY OF STEAM AT 120 PSIG =                      | 1,192 BTU/LBM            |
| SYSTEM EFFICIENCY =                                  | 74%                      |
| NATURAL GAS COST =                                   | \$4.08 MCF               |
| HEAT CONTENT OF NAT. GAS =                           | <u>1,000,000</u> BTU/MCF |
| \$5.87 PER THOUSAND LBS. OF STEAM                    |                          |
| $[(1192-128) \times \$4.08] / (0.74 \times 1,000) =$ |                          |

**COST OF INSPECTING TRAPS AFTER TEST VALVES ARE INSTALLED.**

ASSUMING AN AVERAGE OF 50 TRAPS PER DAY 8 HOURS PER DAY.

|   |   |                    |                 |
|---|---|--------------------|-----------------|
| 8 MH  | x | \$36.75 PER HOUR = | \$294 PER DAY   |
| \$294   | / | 50 TRAPS PER DAY = | \$5.88 PER TRAP |
| COST OF INSTALLING TEST VALVES ON EACH TRAP = |   |                    | \$137           |

**SAVINGS FROM TRAP INSPECTION**

USING 100 TRAPS AS A BASE WITH A 10% FAILURE RATE; 350 LB/HR F&T TRAP

|  |                                |                         |
|--|--------------------------------|-------------------------|
| COST OF INSPECTING TRAPS ONCE DURING THE HEATING SEASON  | 100 X \$5.88 =                 | \$588 PER YEAR          |
| NUMBER OF TRAPS FAILED                                   | 100 X 10% =                    | 10 TRAPS                |
| COST OF REPAIRING TRAPS                                  | 10 X \$145 =                   | \$1,450 PER YEAR        |
| TOTAL COST OF INSPECTING AND REPAIRING TRAPS             |                                | <u>\$2,038</u> PER YEAR |
| 65 lbs/hr x 4380 hrs/yr x 0.5 (sys. modulation factor) = | 142,350 LBS. OF STEAM PER YEAR |                         |
| 142,350 x (1192-128) / 1,000,000 =                       | 151 MBTU / YEAR / TRAP         |                         |
| 151 x \$5.87 =   | \$886 PER TRAP / YEAR          |                         |
| ENERGY LOST DUE TO FAILED TRAPS                          | 10 X 151 =                     | 1510 MBTU'S PER YEAR    |
| COST OF STEAM LOST DUE TO FAILED TRAPS                   | 10 X \$886 =                   | \$8,860 PER YEAR        |
| INITIAL INVESTMENT FOR TEST VALVES                       | 100 X \$137 =                  | \$13,700                |
| CONSTRUCTION COST  | \$2,038 + \$13,700 =           | \$15,738                |

|                          |   |  |                            |
|--------------------------|---|--|----------------------------|
| <b>CALCULATION SHEET</b> |   | DATE<br><b>March, 1987</b>   | SHEET <b>1</b> OF <b>1</b> |
| PROJECT                  | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |                            |
| LOCATION                 |   |  |                            |
| ARCHITECT/ENGINEER       | CLARK RICHARDSON & BISKUP                 |  |                            |
| ECO MEASURE              | STEAM TRAP PROGRAM - OUTSIDE TESTING      | COMPUTED BY<br>TGD   | CHECKED BY<br>MAW          |

**COST OF STEAM AT FORT LEAVENWORTH - USDB**

|  |                          |
|--|--------------------------|
| ENTHALPY OF WATER AT 160° F. =                       | 128 BTU/LBM              |
| ENTHALPY OF STEAM AT 120 PSIG =                      | 1,192 BTU/LBM            |
| SYSTEM EFFICIENCY =                                  | 74%                      |
| NATURAL GAS COST =                                   | \$4.08 MCF               |
| HEAT CONTENT OF NAT. GAS =                           | <u>1,000,000</u> BTU/MCF |
| \$5.87 PER THOUSAND LBS. OF STEAM                    |                          |
| $[(1192-128) \times \$4.08] / (0.74 \times 1,000) =$ |                          |

**COST OF INSPECTING TRAPS USING AN OUTSIDE TESTING SERVICE.**

ASSUMING AN AVERAGE OF 50 TRAPS PER DAY, 8 HOURS PER DAY.  
THE COST IS A FLAT FEE OF \$500 PER DAY.

\$500/50 TRAPS = \$10 PER TRAP

COST OF INSTALLING TEST VALVES ON EACH TRAP = \$137

**SAVINGS FROM TRAP INSPECTION**

USING 100 TRAPS AS A BASE WITH A 10% FAILURE RATE; 350 LB/HR F&T TRAP

|  |                                |                         |
|--|--------------------------------|-------------------------|
| COST OF INSPECTING TRAPS ONCE DURING THE HEATING SEASON  | 100 X \$10 =                   | \$1,000 PER YEAR        |
| NUMBER OF TRAPS FAILED                                   | 100 X 10% =                    | 10 TRAPS                |
| COST OF REPAIRING TRAPS                                  | 10 X \$145 =                   | \$1,450 PER YEAR        |
| TOTAL COST OF INSPECTING AND REPAIRING TRAPS             |                                | <u>\$2,450</u> PER YEAR |
| 65 lbs/hr x 4380 hrs/yr x 0.5 (sys. modulation factor) = | 142,350 LBS. OF STEAM PER YEAR |                         |
| 142,350 x (1192-128)/1,000,000 =                         | 151 MBTU / YEAR / TRAP         |                         |
| 151 x \$5.87 =   | \$886 PER TRAP / YEAR          |                         |
| ENERGY LOST DUE TO FAILED TRAPS                          | 10 X 151 =                     | 1510 MBTU'S PER YEAR    |
| COST OF STEAM LOST DUE TO FAILED TRAPS                   | 10 X \$886 =                   | \$8,860 PER YEAR        |
| INITIAL INVESTMENT FOR TEST VALVES                       | 100 X \$137 =                  | \$13,700                |
| CONSTRUCTION COST  | \$2,450 + \$13,700 = \$16,150  |                         |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-23-90

DISCRETE PORTION NAME: ECOM3 - OWNER TESTING  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

1. INVESTMENT

|                                     |     |        |
|-------------------------------------|-----|--------|
| A. CONSTRUCTION COST                | \$  | 15738. |
| B. SIOH                             | \$  | 944.   |
| C. DESIGN COST                      | \$  | 866.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 15793. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 15793. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 1510.                 | \$ 6161.                | 11.67                 | 71899.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 1510.                 | \$ 6161.                |                       | \$ 71899.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |        |
|---|-------|--------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.     |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11  |        |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.     |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.     |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |        |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 23727. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |        |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     | _____ |        |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |        |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |        |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 6161.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 71899. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 4.55 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.56 |        |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7

PROJECT NO. & TITLE: 1496

FISCAL YEAR 1990

ANALYSIS DATE: 03-23-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOM3 - OUTSIDE TESTING  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

1. INVESTMENT

|                                     |     |        |
|-------------------------------------|-----|--------|
| A. CONSTRUCTION COST                | \$  | 16150. |
| B. SIOH                             | \$  | 969.   |
| C. DESIGN COST                      | \$  | 888.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 16206. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 16206. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 1510.                 | \$ 6161.                | 11.67                 | 71899.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 1510.                 | \$ 6161.                |                       | \$ 71899.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |           |    |
|---|-----------|----|
| A. ANNUAL RECURRING (+/-)                                     | \$        | 0. |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11      |    |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$        | 0. |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$        | 0. |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |           |    |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$ 23727. |    |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |           |    |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F= _____               |           |    |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |           |    |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |           |    |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 6161.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 71899. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 4.44 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    |      | 2.63   |

|  |                  |                   |                 |   |                 |                      |              |
|--|------------------|-------------------|-----------------|---|-----------------|----------------------|--------------|
| <b>CONSTRUCTION COST ESTIMATE</b>  |                  |                   |                 | <b>DATE PREPARED</b>  |                 | <b>SHEET OF</b><br>1 |              |
| <b>PROJECT</b><br>USDB ENERGY STUDY<br><b>LOCATION</b><br>FORT LEAVENWORTH, KS<br><b>ARCHITECT/ENGINEER</b><br>CLARK RICHARDSON & BISKUP |                  |                   |                 | <b>BASIS FOR ESTIMATE</b><br><input checked="" type="checkbox"/> <b>CODE A (NO DESIGN COMPLETED)</b><br><input type="checkbox"/> <b>CODE B (PRELIMINARY DESIGN)</b><br><input type="checkbox"/> <b>CODE C (FINAL DESIGN)</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                 |                      |              |
| <b>DRAWING NO.</b>   |                  | <b>ESTIMATOR</b>  |                 | <b>TGD</b>  |                 | <b>CHECKED BY</b>    |              |
|  | <b>QUANTITY</b>  | <b>MATERIAL</b>   |                 | <b>LABOR</b>  |                 | <b>TOTAL COST</b>    |              |
|  | <b>NO. UNITS</b> | <b>UNIT MEAS.</b> | <b>PER UNIT</b> | <b>TOTAL</b>  | <b>PER UNIT</b> | <b>TOTAL</b>         |              |
| INSTALL TEST VALVE (PER TRAP)  |                  |                   |                 |   |                 |                      |              |
| CREW 1 STEAM FITTER, 1 APPRENTICE  |                  |                   |                 |   |                 |                      |              |
| DISCONNECT EXISTING PIPE   | 1.00             | MH                | \$22.27         | \$22  | \$20.00         | \$20                 | \$42         |
| INSTALL TEE AND TEST LINE  | 0.75             | MH                | \$22.27         | \$17  | \$5.40          | \$4                  | \$21         |
| INSTALL GLOBE VALVE  | 0.75             | MH                | \$22.27         | \$17  | \$17.10         | \$13                 | \$30         |
|  |                  |                   |                 |   |                 |                      |              |
|  |                  |                   |                 |   |                 |                      |              |
|  |                  |                   |                 |   |                 |                      |              |
|  |                  |                   |                 |   |                 |                      |              |
|  |                  |                   |                 |   |                 |                      |              |
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|  |                  |                   |                 |   |                 |                      |              |
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|  |                  |                   |                 |   |                 |                      |              |
|  |                  |                   |                 |   |                 |                      |              |
|  |                  |                   |                 |   |                 |                      |              |
| SUBTOTAL   |                  |                   |                 | \$56  |                 | \$37                 | \$93         |
| CONTINGENCY 10%  |                  |                   | 10%             | \$6   | 10%             | \$4                  | \$10         |
| SUBTOTAL   |                  |                   |                 | \$62  |                 | \$41                 | \$103        |
| WORK COMP, TAX, SOC. SEC., INS   |                  |                   | 3.50%           | \$2   | 13.0%           | \$5                  | \$7          |
| DIRECT COST  |                  |                   |                 | \$64  |                 | \$46                 | \$110        |
| OVERHEAD AND PROFIT  |                  |                   | 25%             | \$16  | 25%             | \$11                 | \$27         |
| SUBTOTAL   |                  |                   |                 | \$80  |                 | \$57                 | \$137        |
| <b>CONSTRUCTION COST PER TRAP</b>  |                  |                   |                 |   |                 |                      | <b>\$137</b> |

ENG. FORM 150  
1AVC-59

# **ECO-M12**

**REDUCE STEAM  
DISTRIBUTION PRESSURE**



|   |  |  |                          |                |
|---|--|--|--------------------------|----------------|
| <b>CALCULATION SHEET</b>                                    |  | <b>DATE</b><br>Mar-90  | <b>SHEET</b><br>1        | <b>OF</b><br>1 |
| <b>PROJECT</b><br>USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                |
| <b>LOCATION</b><br>STEAM PLANT                              |  |  |                          |                |
| <b>ARCHITECT/ENGINEER</b><br>CLARK RICHARDSON & BISKUP      |  |  |                          |                |
| <b>ECO MEASURE</b><br>ECO M12                               |  | <b>COMPUTED BY</b><br>TGD  | <b>CHECKED BY</b><br>MAW |                |

| STEAM<br>PRESSURE | ENTHALPY<br>BTU/LB. OF STEAM | SYSTEM<br>EFFICIENCY | STEAM COST<br>PER 1000 LBS. | ESTIMATED<br>ANNUAL SAVINGS |
|-------------------|------------------------------|----------------------|-----------------------------|-----------------------------|
| 120 PSIG          | 1,192.4                      | 74.000%              | \$5.754                     | NONE                        |
| 115 PSIG          | 1,191.7                      | 74.094%              | \$5.742                     | \$326                       |
| 110 PSIG          | 1,191.0                      | 74.188%              | \$5.731                     | \$624                       |
| 105 PSIG          | 1,190.4                      | 74.282%              | \$5.721                     | \$896                       |
| 100 PSIG          | 1,189.6                      | 74.376%              | \$5.709                     | \$1,222                     |
| 95 PSIG           | 1,188.8                      | 74.470%              | \$5.698                     | \$1,520                     |
| 90 PSIG           | 1,188.0                      | 74.564%              | \$5.686                     | \$1,846                     |
| 85 PSIG           | 1,187.2                      | 74.658%              | \$5.675                     | \$2,145                     |
| 80 PSIG           | 1,186.3                      | 74.752%              | \$5.663                     | \$2,470                     |

AVERAGE STEAM USE FOR SPACE HEATING:

ANNUAL ENERGY SAVINGS (AT 80 PSIG):

SYSTEM EFFICIENCY CALCULATED FROM:

IMPROVING BOILER EFFICIENCY BY S.G. DUKELOW

SPONSORED BY KANSAS STATE UNIVERSITY AND KANSAS ENERGY OFFICE

CHAPTER 6: EFFECT OF BOILER STEAM PRESSURE ON FLUE GAS TEMPERATURE AND BOILER EFFICIENCY

74,375 LBS PER DAY

605 MBTU'S PER YEAR

ENG. FORM 150  
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 03-19-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: ECOM12

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |     |       |
|-------------------------------------|-----|-------|
| A. CONSTRUCTION COST                | \$  | 9369. |
| B. SIOH                             | \$  | 562.  |
| C. DESIGN COST                      | \$  | 515.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 9401. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 9401. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 605.                  | \$ 2468.                | 11.67                 | 28802.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 605.                  | \$ 2468.                |                       | \$ 28802.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |       |
|---|------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 9505. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |       |

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 2468.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 28802.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 3.06  
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 3.81

# **ECO-M14**

**SERVICE CONDENSATE  
RETURN SYSTEM**

|                    |   |                |                   |
|--------------------|---|----------------|-------------------|
| CALCULATION SHEET  |   | DATE<br>Mar-90 | SHEET OF<br>1 1   |
| PROJECT            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY               |                |                   |
| LOCATION           | X HAND<br>COMPUTER<br>CONTRACTOR BID<br>OTHER (SPECIFY) |                |                   |
| ARCHITECT/ENGINEER | CLARK RICHARDSON & BISKUP                               |                |                   |
| ECO MEASURE        | SERVICE CONDENSATE RETURN SYSTEM ECO-M14                |                |                   |
| COMPUTED BY        |   | TGD            | CHECKED BY<br>MAW |

| INIT<br>TEMP | AMB<br>TEMP | INSUL<br>THICK | WIND<br>VEL | PIPE<br>DIA | INSULATION CHARACTERISTICS |      |     |       | PIPE<br>LEN | FLOW<br>#/HR | SPEC<br>HEAT | EMISS | FINAL<br>TEMP | TOTAL<br>HL |
|--------------|-------------|----------------|-------------|-------------|----------------------------|------|-----|-------|-------------|--------------|--------------|-------|---------------|-------------|
|              |             |                |             |             | T 1                        | CON1 | T2  | CON 2 |             |              |              |       |               |             |
| 212          | 75          | 2              | 1           | 8.625       | 460                        | 0.5  | 100 | 0.25  | 700         | 6200         | 1.05         | 0.9   | 201.1         | 71,040      |
| 212          | 75          | 0.001          | 1           | 8.625       | 460                        | 0.5  | 100 | 0.25  | 700         | 6200         | 1.05         | 0.9   | 154.9         | 371,640     |

|                           |   |  |                        |
|---------------------------|---|--|------------------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET OF</b><br>1 1 |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b>   |                        |
| <b>LOCATION</b>           |   | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                        |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 | <b>COMPUTED BY</b><br>TGD  | <b>CHECKED BY</b>      |
| <b>ECO MEASURE</b>        | SERVICE CONDENSATE RETURN SYSYTEM ECO-M14 |  |                        |

|                                      |                         |
|--------------------------------------|-------------------------|
| 120 PSIG STEAM PRESSURE:             | 1192.4 BTU/LB. ENTHALPY |
| 155°F CONDENSATE RETURN TEMPERATURE: | 123 BTU/LB. ENTHALPY    |
| 201°F CONDENSATE RETURN TEMPERATURE: | 169 BTU/LB. ENTHALPY    |
| SYSTEM EFFCIENCY:                    | 74%                     |
| AVERAGE DAILY STEAM CONSUMPTION:     | 148,750 LBS.            |
| STEAM LOAD SERVED BY WEST TUNNEL:    | 50%                     |
| DAYS PER YEAR:                       | 365                     |

|   |   |                 |
|---|---|-----------------|
| $(1192.4 - 123) - (1192.4 - 169) / 0.74$                  | = | 62.16 BTU/LB.   |
| $(62.16 \times 148,750 \times .5 \times 365) / 1,000,000$ | = | 1,687 MBTU/YEAR |

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: ECOM14

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |     |        |
|-------------------------------------|-----|--------|
| A. CONSTRUCTION COST                | \$  | 35958. |
| B. SIOH                             | \$  | 2157.  |
| C. DESIGN COST                      | \$  | 1978.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 36084. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 36084. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                |                       | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 1687.                 | \$ 6883.                | 11.67                 | 80325.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 1687.                 | \$ 6883.                |                       | \$ 80325.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |        |
|---|------|--------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.     |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |        |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.     |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.     |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |        |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 26507. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |        |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |        |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |        |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |        |

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 6883.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 80325.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.23  
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 5.24

| <b>CONSTRUCTION COST ESTIMATE</b>                      |           |            |                         | <b>DATE PREPARED</b><br>Mar-90  |                          |          | <b>SHEET OF</b><br>1 1 |            |
|--|-----------|------------|-------------------------|---|--------------------------|----------|------------------------|------------|
| <b>PROJECT</b><br>USDB ENERGY STUDY                    |           |            |                         | <b>BASIS FOR ESTIMATE</b><br><br><input checked="" type="checkbox"/> <b>CODE A (NO DESIGN COMPLETED)</b><br><input type="checkbox"/> <b>CODE B (PRELIMINARY DESIGN)</b><br><input type="checkbox"/> <b>CODE C (FINAL DESIGN)</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |          |                        |            |
| <b>LOCATION</b><br>FORT LEAVENWORTH, KS                |           |            |                         |   |                          |          |                        |            |
| <b>ARCHITECT/ENGINEER</b><br>CLARK RICHARDSON & BISKUP |           |            |                         |   |                          |          |                        |            |
| <b>DRAWING NO.</b>                                     |           |            | <b>ESTIMATOR</b><br>TGD |   | <b>CHECKED BY</b><br>MAW |          |                        |            |
|  | QUANTITY  |            | PER UNIT                | MATERIAL  |                          | LABOR    |                        | TOTAL COST |
|  | NO. UNITS | UNIT MEAS. |                         | TOTAL   | PER UNIT                 | TOTAL    |                        |            |
| 6" DIA. - 2" THICK FIBERGLASS INSULATION               | 400       | LF         | \$5.87                  | \$2,348   | \$3.45                   | \$1,380  | \$3,728                |            |
| ALUMINUM JACKET  | 400       | LF         | \$0.54                  | \$216   | \$2.87                   | \$1,148  | \$1,364                |            |
| 8" DIA. SCH. 80 STEEL PIPE                             | 100       | LF         | \$37.66                 | \$3,766   | \$22.00                  | \$2,200  | \$5,966                |            |
| 8" DIA. - 2" THICK FIBERGLASS INSULATION               | 200       | LF         | \$7.25                  | \$1,450   | \$4.31                   | \$862    | \$2,312                |            |
| ALUMINUM JACKET  | 200       | LF         | \$0.54                  | \$108   | \$2.87                   | \$574    | \$682                  |            |
| PIPE RACKS   | 6         | EA         | \$400                   | \$2,400   | \$200                    | \$1,200  | \$3,600                |            |
| REPAIR HOLES IN PIPING                                 | 3         | DAYS       |                         |   | \$252                    | \$756    | \$756                  |            |
| 8" DIA. TEE  | 2         | EA         | \$71                    | \$142   | \$71                     | \$142    | \$284                  |            |
| 8" DIA. 90° ELBOW                                      | 2         | EA         | \$100                   | \$200   | \$140                    | \$280    | \$480                  |            |
| DEMOLITION   | 100       | LF         |                         |   | \$3.95                   | \$395    | \$395                  |            |
|  |           |            |                         |   |                          |          |                        |            |
|  |           |            |                         |   |                          |          |                        |            |
|  |           |            |                         |   |                          |          |                        |            |
|  |           |            |                         |   |                          |          |                        |            |
| <b>SUBTOTAL</b>  |           |            |                         | \$10,630  |                          | \$8,937  | \$19,567               |            |
| DIFFICULTY FACTOR 50%                                  |           |            |                         |   | 50%                      | \$4,469  | \$4,469                |            |
| <b>SUBTOTAL</b>  |           |            |                         |   |                          | \$13,406 | \$24,036               |            |
| CONTINGENCY 10%  |           |            | 10%                     | \$1,063   | 10%                      | \$1,341  | \$2,404                |            |
| <b>SUBTOTAL</b>  |           |            |                         | \$11,693  |                          | \$14,747 | \$26,440               |            |
| WORK COMP, TAX, SOC. SEC., INS                         |           |            | 3.50%                   | \$409   | 13.0%                    | \$1,917  | \$2,326                |            |
| <b>DIRECT COST</b>                                     |           |            |                         | \$12,102  |                          | \$16,664 | \$28,766               |            |
| OVERHEAD AND PROFIT                                    |           |            | 25%                     | \$3,026   | 25%                      | \$4,166  | \$7,192                |            |
| <b>SUBTOTAL</b>  |           |            |                         | \$15,128  |                          | \$20,830 | \$35,958               |            |
| <b>CONSTRUCTION COST</b>                               |           |            |                         |   |                          |          | \$35,958               |            |

ENG. FORM 150  
1AVC-59



# **ECO-M15**

**BOILER PLANT  
MODIFICATIONS**

|                           |   |  |                          |                |
|---------------------------|---|--|--------------------------|----------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET</b><br>1        | <b>OF</b><br>1 |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b>   |                          |                |
| <b>LOCATION</b>           | FORT LEAVENWORTH, KANSAS                  | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 |  |                          |                |
| <b>ECO MEASURE</b>        | ECO-M15 O2 TRIM CONTROLS                  | <b>COMPUTED BY</b><br>BMS  | <b>CHECKED BY</b><br>MAW |                |

**BUILDING 474 - CENTRAL HEATING PLANT**

**TEST DATA, BOILER #2**

|                       |         |
|-----------------------|---------|
| % OXYGEN              | 6.3 %   |
| STACK TEMPERATURE     | 450 ° F |
| % EXCESS AIR          | 37. %   |
| COMBUSTION EFFICIENCY | 80.50%  |
| %CO 2                 | 8.3 %   |

STEAM PRODUCTION, ACCORDING TO BOILER PLANT OPERATORS:

|                      |                 |
|----------------------|-----------------|
| SUMMER               | 75,000 LBS/DAY  |
| WINTER               | 370,000 LBS/DAY |
| AVERAGE (CALCULATED) | 148,750 LBS/DAY |

BOILER TRIM CONTROL REDUCES EXCESS AIR TO 15%

FROM "GAS COMBUSTION EFFICIENCY CHART" PUBLISHED BY COOPERATIVE EXTENSION SERVICE, KANSAS STATE UNIVERSITY, MANHATTAN KS.:

15% EXCESS AIR AT 317°F = 84.50% COMBUSTION EFF.

84.50% - 80.50% = 4.00% INCREASE IN COMB. EFF.

|   |               |
|---|---------------|
| ENTHALPY OF STEAM LEAVING BOILERS           | 1192.4 BTU/LB |
| ENTHALPY OF CONDENSATE RETURNING TO BOILERS | 128 BTU/LB    |
| ENTHALPY DIFFERENCE                         | 1064.4 BTU/LB |

148,750 LBS/DAY X 1,064 BTU/LB X 365 DAYS/YR > 0.000001 MBTU/BTU =

57,769 MBTU/YR.

THIS TRANSLATES TO GAS CONSUMPTIONS OF

57,769 / 80.50% = 71,763 MBTU/YR.

AND

57,769 / 84.50% = 68,366 MBTU/YR. WITH O2 TRIM CONTROLS.

SAVINGS

71,763 - 68,366 = 3,397 MBTU/YR.

4.08 X 3,397 = \$13,860 PER YEAR

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-28-90

DISCRETE PORTION NAME: ECOM1502  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

1. INVESTMENT

|                                     |     |        |
|-------------------------------------|-----|--------|
| A. CONSTRUCTION COST                | \$  | 36865. |
| B. SIOH                             | \$  | 2212.  |
| C. DESIGN COST                      | \$  | 2028.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 36995. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 36995. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 3397.                 | \$ 13860.               | 11.67                 | 161746.                  |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 3397.                 | \$ 13860.               |                       | \$ 161746.               |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |        |
|---|------|--------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.     |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |        |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.     |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.     |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |        |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 53376. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |        |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |        |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |        |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |        |

|  |      |         |
|--|------|---------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 13860.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 161746. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 4.37 |         |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |         |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 2.67 |         |

|  |                 |            |                         |   |                          |                      |                   |
|--|-----------------|------------|-------------------------|---|--------------------------|----------------------|-------------------|
| <b>CONSTRUCTION COST ESTIMATE</b>                      |                 |            |                         | <b>DATE PREPARED</b><br>Mar-90  |                          | <b>SHEET OF</b><br>1 |                   |
| <b>PROJECT</b><br>USDB ENERGY STUDY                    |                 |            |                         | <b>BASIS FOR ESTIMATE</b><br><br><input checked="" type="checkbox"/> <b>CODE A (NO DESIGN COMPLETED)</b><br><input type="checkbox"/> <b>CODE B (PRELIMINARY DESIGN)</b><br><input type="checkbox"/> <b>CODE C (FINAL DESIGN)</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                      |                   |
| <b>LOCATION</b><br>FORT LEAVENWORTH, KS                |                 |            |                         |   |                          |                      |                   |
| <b>ARCHITECT/ENGINEER</b><br>CLARK RICHARDSON & BISKUP |                 |            |                         |   |                          |                      |                   |
| <b>DRAWING NO.</b><br>NONE                             |                 |            | <b>ESTIMATOR</b><br>BMS |   | <b>CHECKED BY</b><br>MAW |                      |                   |
| ECO-M15  | <b>QUANTITY</b> |            | <b>MATERIAL</b>         |   | <b>LABOR</b>             |                      | <b>TOTAL COST</b> |
|  | NO. UNITS       | UNIT MEAS. | PER UNIT                | TOTAL   | PER UNIT                 | TOTAL                |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
| OXYGEN TRIM CONTROL                                    | 3               | EA         | \$2,100                 | \$6,300   | \$5,985                  | \$17,955             | \$24,255          |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
|  |                 |            |                         |   |                          |                      |                   |
| SUBTOTAL   |                 |            |                         | \$6,300   |                          | \$17,955             | \$24,255          |
| CONTINGENCY 10%  |                 |            | 10%                     | \$630   | 10%                      | \$1,796              | \$2,426           |
| SUBTOTAL   |                 |            |                         | \$6,930   |                          | \$19,751             | \$26,681          |
| WORK COMP, TAX, SOC. SEC., INS                         |                 |            | 3.50%                   | \$243   | 13.0%                    | \$2,568              | \$2,811           |
| DIRECT COST  |                 |            |                         | \$7,173   |                          | \$22,319             | \$29,492          |
| OVERHEAD AND PROFIT                                    |                 |            | 25%                     | \$1,793   | 25%                      | \$5,580              | \$7,373           |
| SUBTOTAL   |                 |            |                         | \$8,966   |                          | \$27,899             | \$36,865          |
| <b>CONSTRUCTION COST</b>                               |                 |            |                         |   |                          |                      | <b>\$36,865</b>   |

ENG. FORM 150  
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 12-5-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: GROUP #4

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |    |        |
|-------------------------------------|----|--------|
| A. CONSTRUCTION COST                | \$ | 98342. |
| B. SIOH                             | \$ | 5901.  |
| C. DESIGN COST                      | \$ | 5409.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$ | 98687. |
| E. SALVAGE VALUE COST               | \$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$ | 98687. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 7199.                 | \$ 29372.               | 11.67                 | 342771.                  |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 7199.                 | \$ 29372.               |                       | \$ 342771.               |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |         |
|---|------|---------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.      |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |         |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.      |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.      |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |         |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 113114. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |         |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |         |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |         |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |         |

|  |      |         |
|--|------|---------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 29372.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 342771. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 3.47 |         |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |         |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 3.36 |         |

## FACILITIES ENGINEERING WORK REQUEST - XFA XFB XFC

et of Engineers.

[illegible]

ATION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

Make the following boiler plant modifications:

- Inspect and service or replace steam traps.
- Upon replacement of existing boilers, reduce steam distribution pressure from 120 psig to 80 psig for all steam loads at the US except the laundry, served by a separate 120 psig boiler.
- Replace approximately 100 feet of 8" condensate piping. Insulate approximately 400 feet of 6" piping and 200 feet of 8" piping.
- Purchase oxygen trim controls for any new boilers.

These energy conservation measures will show economic payback.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

The boiler plant in building 474 will continue to waste approximately 7,199 million BTU's per year that could be saved by implementing these measures.

PERSON TO CALL FOR ADDITIONAL INFORMATION

NON-NEGOTIABLE

WZ02

## ATURE

02012333

ORGANIZATION

---

| FORWARD FOR APPROVAL |                                     |                          |                              | ESTIMATED COST | WORK TO BE PERFORMED               | FROM                |
|----------------------|-------------------------------------|--------------------------|------------------------------|----------------|------------------------------------|---------------------|
| RECOMMENDED ACTION   | NO                                  | YES                      | ENVIRONMENTAL CONSIDERATIONS | FUNDED \$      | <input type="checkbox"/> IN-HOUSE  | FACILITIES ENGINEER |
|                      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                              | WC \$          | <input type="checkbox"/> SELF-HELP |                     |
|                      |                                     | <input type="checkbox"/> | EIS/EIA                      | WC \$          | <input type="checkbox"/> CONTRACT  |                     |
|                      | <input checked="" type="checkbox"/> | <input type="checkbox"/> | INITIATED                    | WC \$          | <input type="checkbox"/> TROOP     |                     |
|                      | <input checked="" type="checkbox"/> | <input type="checkbox"/> | EIS/EIA COMPLETED            | UNFUNDED \$    |                                    |                     |
|                      |                                     |                          | TOTAL                        | \$             |                                    |                     |
| SIGNING AUTHORITY    |                                     |                          |                              |                |                                    |                     |

| APPROVAL ACTION   |   |      |   |              |    |      |    |              |           |
|---|---|------|---|--------------|----|------|----|--------------|-----------|
| DOCUMENT NUMBER   |   |      |   | ACTION TAKEN |    | DATE |    | FORWARDED TO |           |
| SERIAL NUMBER   |   | TYPE |   |              |    | MO   | DA | DESIGN       | ESTIMATOR |
| 5   | 6 | 7    | 8 | 9            | 10 | 11   | 12 | 13           | 14        |
| <div style="display: flex; justify-content: space-between;"> <div> <p>A - APPROVED</p> <p>O - DISAPPROVED</p> </div> <div> <p>SIGNATURE OF APPROVAL AUTHORITY</p> </div> </div> |   |      |   |              |    |      |    |              |           |

|      |      |                         |
|------|------|-------------------------|
| 4787 | 4787 | REUSED UNTIL EXHAUSTED. |
|------|------|-------------------------|

GBOIIP4 - PAGE 18

- PROJECT FILE COPY
- FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL ACTION" BLOCK

2356

- FORWARD TO KEYPUNCH AFTER COMPLETION  
OF "APPROVAL ACTION" BLOCK

FORWARD TO KEYPUNCH AFTER  
COMPLETION OF "FORWARD FC  
APPROVAL" BLOCK

## **GROUP 5**

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                          |                            | ECO     | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR  |
|--|----------------------------|---------|------------------------------|-------------------------|-----------------------|--------------------------|------|
| <b>GROUP 5</b><br>Building 475 Repairs |                            |         |                              |                         |                       |                          |      |
| 475                                    | Attic Insulation - Rotunda | ECO-A3  | 142                          | \$578                   | \$4,868               | 7.96                     | 2.03 |
| 475                                    | Exhaust Heat Recovery      | ECO-M5  | 453                          | \$2,130                 | \$12,909              | 6.66                     | 1.76 |
| 475C                                   | Air System Repair          | ECO-M11 | 273                          | \$1,458                 | \$1,779               | 1.51                     | 7.72 |
| 475D                                   | Air System Repair          | ECO-M11 | 277                          | \$1,474                 | \$1,779               | 1.49                     | 7.83 |
| 475F                                   | Air System Repair          | ECO-M11 | 307                          | \$1,641                 | \$1,779               | 1.34                     | 8.68 |
| 475G                                   | Air System Repair          | ECO-M11 | 247                          | \$1,323                 | \$1,779               | 1.67                     | 6.99 |
| 475A                                   | Lighting Levels - Chapel   | ECO-E1  | 3                            | \$43                    | \$213                 | 4.70                     | 2.40 |
| 475B                                   | Lighting Levels            | ECO-E1  | 3                            | \$40                    | \$213                 | 5.00                     | 2.20 |
| 475H                                   | Lighting Levels            | ECO-E1  | 2                            | \$21                    | \$213                 | 9.50                     | 1.20 |
| 475A                                   | Energy Efficient Lighting  | ECO-E2  | 8                            | \$100                   | \$131                 | 1.24                     | 9.00 |
| GROUP 5 TOTALS                         |                            |         | 1,715                        | \$8,808                 | \$25,663              | 3.40                     | 3.41 |
| GROUP 5 FUNDING CATEGORY: PECIP        |                            |         |                              |                         |                       |                          |      |



**ECO-A3**

**ATTIC INSULATION**

## ECO-A3 ECONOMIC ANALYSIS

| BUILDING<br>NUMBER | STEAM CONSUMPTION          |                            |                             | ELECTRIC CONSUMPTION |                        |                             | TOTAL<br>SAVINGS<br>(\$) |
|--------------------|----------------------------|----------------------------|-----------------------------|----------------------|------------------------|-----------------------------|--------------------------|
|                    | BASE<br>ENERGY<br>(THERMS) | ECO-A3<br>LOAD<br>(THERMS) | ENERGY<br>SAVINGS<br>(MBTU) | BASE<br>LOAD<br>(KW) | ECO-A3<br>LOAD<br>(KW) | ENERGY<br>SAVINGS<br>(MBTU) |                          |
| 463                | 1,577                      | 1,379                      | 20                          | 83,903               | 82,814                 | 4                           | \$127                    |
| 464                | 2,195                      | 1,311                      | 88                          | 91,802               | 86,441                 | 18                          | \$588                    |
| 472                | 15,515                     | 15,241                     | 27                          | 234,490              | 232,543                | 7                           | \$194                    |
| 475                | 13,619                     | 12,203                     | 142                         | 58,399               | 58,386                 | 0                           | \$578                    |
| 475E               | 21,657                     | 21,253                     | 40                          | 611,712              | 611,617                | 0                           | \$169                    |
|                    |                            |                            |                             |                      |                        |                             | \$1,657                  |

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: 475A3  
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |     |       |
|-------------------------------------|-----|-------|
| A. CONSTRUCTION COST                | \$  | 4592. |
| B. SIOH                             | \$  | 276.  |
| C. DESIGN COST                      | \$  | 253.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 4609. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 4609. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 11.16                 | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 142.                  | \$ 579.                 | 16.15                 | 9351.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 142.                  | \$ 579.                 |                       | \$ 9351.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |       |
|---|-------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 3086. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |       |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |       |

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 579.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 9351.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 2.03  
 (IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 7.96



**ECO-M5**

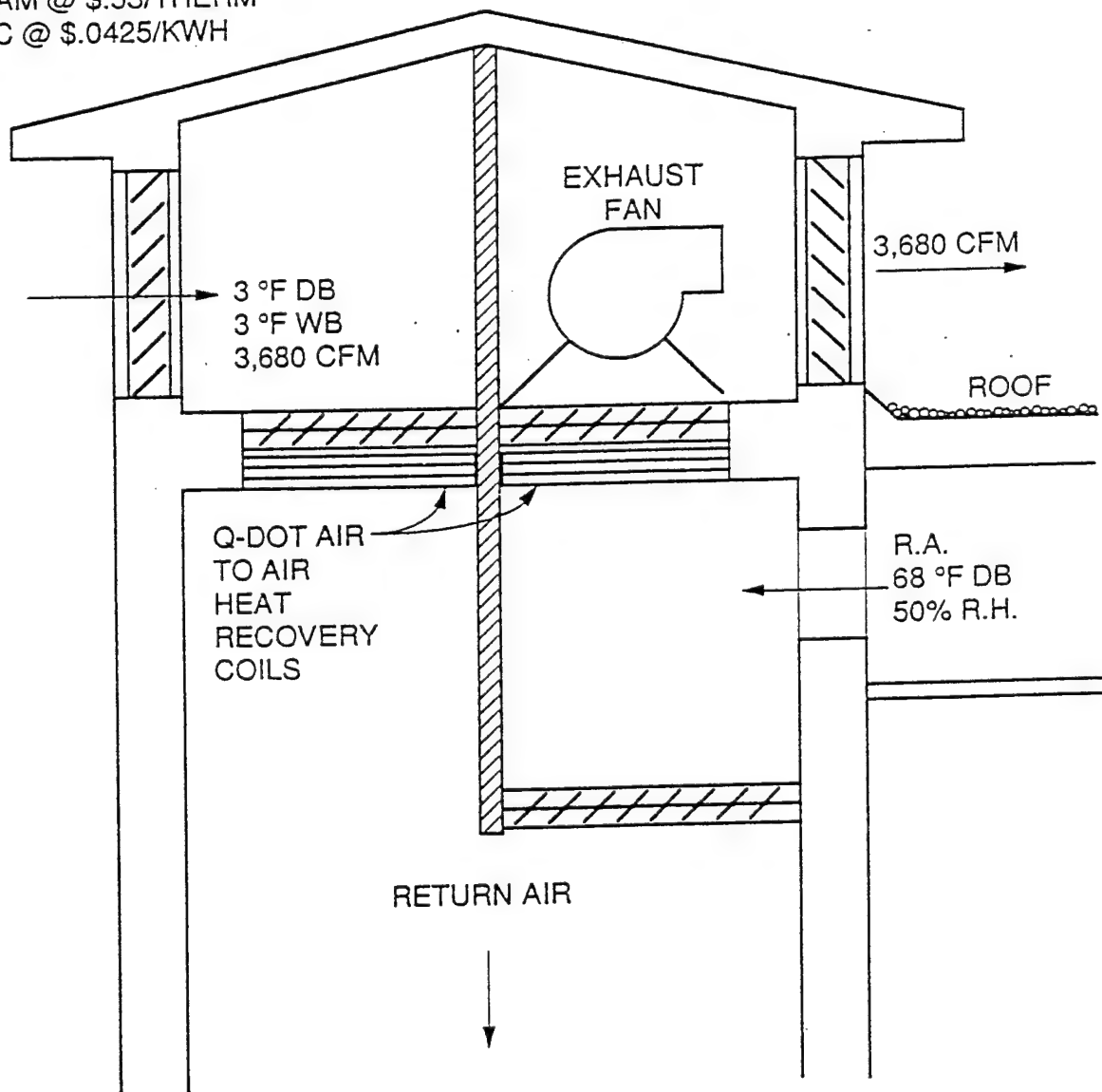
**EXHAUST HEAT RECOVERY**

|                    |   |  |                   |            |
|--------------------|---|--|-------------------|------------|
| CALCULATION SHEET  |   | DATE<br>Mar-90   | SHEET<br>1        | OF OF<br>1 |
| PROJECT            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | BASIS FOR CALCULATION  |                   |            |
| LOCATION           | FORT LEAVENWORTH, KANSAS                  | <input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |                   |            |
| ARCHITECT/ENGINEER | CLARK RICHARDSON & BISKUP                 | COMPUTED BY<br>RGB   | CHECKED BY<br>MAW |            |
| ECO MEASURE        | ECO-M5: HEAT RECOVERY                     |  |                   |            |

OPERATED: 24 HR./DAY, NOVEMBER THROUGH MARCH

STEAM @ \$.53/THERM

ELEC @ \$.0425/KWH



## Q-DOT HEAT RECOVERY SYSTEM TYPICAL SECTION BUILD

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOM5Q  
ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |     |        |
|-------------------------------------|-----|--------|
| A. CONSTRUCTION COST                | \$  | 12178. |
| B. SIOH                             | \$  | 731.   |
| C. DESIGN COST                      | \$  | 670.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 12221. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 12221. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | -1.                   | \$ -12.                 | 8.69                  | -104.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 453.                  | \$ 1848.                | 11.67                 | 21566.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 452.                  | \$ 1836.                |                       | \$ 21462.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |       |
|---|------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 7082. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |       |

4. FIRST YEAR DOLLAR SAVINGS  $2F3+3A+(3B1D)/(YEARS\ ECONOMIC\ LIFE)$  \$ 1836.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 21462.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.76  
(IF < 1 PROJECT DOES NOT QUALIFY)
7. SIMPLE PAYBACK PERIOD (ESTIMATED)  $SPB=1F/4$  6.66

ENG. FORM 150  
1AVC-59



**ECO-M11**

**CASTLE AIR SYSTEM  
REPAIR**

## ECO-M11 ECONOMIC ANALYSIS

| BUILDING<br>NUMBER | STEAM CONSUMPTION          |                             |                             | ELECTRIC CONSUMPTION |                         |                             | TOTAL<br>SAVINGS<br>(\$) |
|--------------------|----------------------------|-----------------------------|-----------------------------|----------------------|-------------------------|-----------------------------|--------------------------|
|                    | BASE<br>ENERGY<br>(THERMS) | ECO-M11<br>LOAD<br>(THERMS) | ENERGY<br>SAVINGS<br>(MBTU) | BASE<br>LOAD<br>(KW) | ECO-M11<br>LOAD<br>(KW) | ENERGY<br>SAVINGS<br>(MBTU) |                          |
| 475C               | 13,472                     | 10,745                      | 273                         | 45,478               | 45,427                  | 0                           | \$1,115                  |
| 475D               | 15,188                     | 12,422                      | 277                         | 53,358               | 53,317                  | 0                           | \$1,130                  |
| 475F               | 15,926                     | 12,856                      | 307                         | 53,357               | 53,324                  | 0                           | \$1,254                  |
| 475G               | 12,853                     | 10,380                      | 247                         | 45,481               | 45,427                  | 0                           | \$1,011                  |
|                    |                            |                             |                             |                      |                         |                             | <b>\$4,510</b>           |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

DISCRETE PORTION NAME: ECOM11C  
ECONOMIC LIFE 15 YEARS

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

PREPARED BY: CRB

|                                     |     |       |
|-------------------------------------|-----|-------|
| 1. INVESTMENT                       |     |       |
| A. CONSTRUCTION COST                | \$  | 1678. |
| B. SIOH                             | \$  | 101.  |
| C. DESIGN COST                      | \$  | 92.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 1684. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 1684. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 273.                  | \$ 1114.                | 11.67                 | 13000.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 273.                  | \$ 1114.                |                       | \$ 13000.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |    |       |
|---|------|----|-------|
| A. ANNUAL RECURRING (+/-)                                     |      | \$ | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |    |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |      | \$ | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |      | \$ | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |    |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       |      | \$ | 4290. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |    |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |    |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |    |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |    |       |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 1114.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 13000. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 7.72 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 1.51 |        |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7

PROJECT NO. & TITLE: 1496

FISCAL YEAR 1990

ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOM11D  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

1. INVESTMENT

|                                     |     |       |
|-------------------------------------|-----|-------|
| A. CONSTRUCTION COST                | \$  | 1678. |
| B. SIOH                             | \$  | 101.  |
| C. DESIGN COST                      | \$  | 92.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 1684. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 1684. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 277.                  | \$ 1130.                | 11.67                 | 13187.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 277.                  | \$ 1130.                |                       | \$ 13187.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |       |
|---|-------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11  |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 4352. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     | _____ |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |       |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 1130.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 13187. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 7.83 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 1.49 |        |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOM11F  
ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

|                                     |     |       |
|-------------------------------------|-----|-------|
| 1. INVESTMENT                       |     |       |
| A. CONSTRUCTION COST                | \$  | 1678. |
| B. SIOH                             | \$  | 101.  |
| C. DESIGN COST                      | \$  | 92.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 1684. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 1684. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 307.                  | \$ 1253.                | 11.67                 | 14623.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 307.                  | \$ 1253.                |                       | \$ 14623.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |       |
|---|------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 4826. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |       |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 1253.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 14623. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 8.68 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 1.34 |        |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOM11G

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |     |       |
|-------------------------------------|-----|-------|
| A. CONSTRUCTION COST                | \$  | 1678. |
| B. SIOH                             | \$  | 101.  |
| C. DESIGN COST                      | \$  | 92.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 1684. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 1684. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 0.                    | \$ 0.                   | 8.69                  | 0.                       |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 247.                  | \$ 1008.                | 11.67                 | 11763.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 247.                  | \$ 1008.                |                       | \$ 11763.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |       |
|---|------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 3882. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |       |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 1008.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 11763. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 6.99 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 1.67 |        |

ENG. FORM 150  
1AVC-59

**ECO-E1**

**LIGHTING LEVELS**



|                           |   |  |                          |                |
|---------------------------|---|--|--------------------------|----------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET</b><br>1        | <b>OF</b><br>1 |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b>   |                          |                |
| <b>LOCATION</b>           | FORT LEAVENWORTH, KS                      | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 |  |                          |                |
| <b>ECO MEASURE</b>        | ECO-E1                                    | <b>COMPUTED BY</b><br>DJG  | <b>CHECKED BY</b><br>MAW |                |

BASED ON THE FOLLOWING INFORMATION:  
 \$200.62 FOR TYPICAL MOTION SENSOR INSTALLATION  
 \$0.0425 PER KWH ELECTRICITY COST  
 11.16 25-YEAR DISCOUNT FACTOR

| BUILDING #<br>AND ROOM TYPE  | LIGHTING<br>WATTS | ANNUAL<br>NORMAL<br>HOURS | ANNUAL<br>HOURS<br>SAVED | ANNUAL<br>KWH<br>SAVED | ANNUAL<br>SAVINGS | PAYBACK<br>IN YEARS | SIR        |
|------------------------------|-------------------|---------------------------|--------------------------|------------------------|-------------------|---------------------|------------|
| 450<br>CONFERENCE ROOM       | 1280              | 2080                      | 624                      | 799                    | \$33.96           | 5.9                 | 1.9        |
| 475A<br>CONFERENCE ROOM      | 640               | 2080                      | 624                      | 399                    | \$16.96           | 11.8                | 0.9        |
| 475A<br>CHAPEL               | 1620              | 2080                      | 624                      | 1011                   | \$42.97           | 4.7                 | 2.4        |
| 475E<br>CONFERENCE ROOM      | 480               | 2080                      | 624                      | 300                    | \$12.75           | 15.7                | 0.7        |
| 475B<br>CHAPEL               | 1500              | 2080                      | 624                      | 936                    | \$39.78           | 5.0                 | 2.2        |
| 475H<br>CHAPEL               | 800               | 2080                      | 624                      | 499                    | \$21.21           | 9.5                 | 1.2        |
| <b>TOTAL<br/>(SIR &gt;1)</b> | <b>5200</b>       | <b>2080</b>               | <b>624</b>               | <b>3245</b>            | <b>\$137.91</b>   | <b>8.7</b>          | <b>1.3</b> |

|   |   |   |                   |
|---|---|---|-------------------|
| <b>CALCULATION SHEET</b>  |   | DATE<br>Oct-90  | SHEET 0F<br>1 1   |
| PROJECT   | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | BASIS FOR CALCULATION<br><br><input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |                   |
| LOCATION  | FORT LEAVENWORTH, KS                      |   |                   |
| ARCHITECT/ENGINEER  | CLARK RICHARDSON & BISKUP                 |   |                   |
| ECO MEASURE   | ECO-E1                                    | COMPUTED BY<br>DJG  | CHECKED BY<br>MAW |
| <u>AVERAGE PAYBACK TIME FOR REPLACING EXISTING SWITCHES<br/>WITH INFRARED MOTION SENSORS FOR VARIOUS SPACES</u>   |   |   |                   |
| ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA<br>ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH  |   |   |                   |
| <u>MOTION SENSOR INSTALLATION COST</u>  |   |   |                   |
|   | \$2.66                                    |   |                   |
| DEMO EXISTING SWITCH BOX  | \$5.76                                    |   |                   |
| DEMO 8' EMT WITH WIRING   | \$53.60                                   |   |                   |
| INSTALL 20', 3/4" EMT   | \$13.60                                   |   |                   |
| INSTALL 40', #12 CONDUCTORS   | \$125.00                                  |   |                   |
| INSTALL MOTION SENSOR   | \$200.62                                  |   |                   |
| TOTAL COST PER INSTALLATION   |   |   |                   |
| <br><u>POSSIBLE ENERGY SAVINGS FOR TYPICAL CONFERENCE ROOM</u>  |   |   |                   |
| LIGHTING LOAD   | 720 WATTS                                 |   |                   |
| ANNUAL LIGHTING TIME  | 2080 HOURS                                |   |                   |
| ANNUAL COST @ \$0.0425 PER KWH  | \$63.65                                   |   |                   |
| ANNUAL SAVINGS IF LIGHTS ARE OFF 30% OF TIME  | \$19.10                                   |   |                   |
| COST OF INSTALLATION  | \$200.62                                  |   |                   |
| PAYBACK TIME  | 10.5 YEARS                                |   |                   |
| <br><u>POSSIBLE ENERGY SAVINGS FOR TYPICAL SMALL OFFICE ROOM</u>  |   |   |                   |
| LIGHTING LOAD   | 320 WATTS                                 |   |                   |
| ANNUAL LIGHTING TIME  | 2080 HOURS                                |   |                   |
| ANNUAL COST @ \$0.0425 PER KWH  | \$28.29                                   |   |                   |
| ANNUAL SAVINGS IF LIGHTS ARE OFF 25% OF TIME  | \$7.07                                    |   |                   |
| COST OF INSTALLATION  | \$200.62                                  |   |                   |
| PAYBACK TIME  | 28.4 YEARS                                |   |                   |
| NOTE: SAVINGS ARE VERY DEPENDENT ON SEVERAL ITEMS, WHICH INCLUDE THE FOLLOWING:<br>1) CURRENT PRACTICES IN SWITCHING LIGHTS OFF. IF PEOPLE NORMALLY TURN LIGHTS OFF WHEN NOT IN USE, ENERGY SAVINGS WILL BE MINIMAL.<br>2) AMOUNT OF TIME THAT LIGHTS WILL NOT BE IN USE. THE ABOVE ESTIMATES MAY VARY AND ACTUAL SAVINGS WILL FLUCTUATE ACCORDINGLY. |   |   |                   |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOE1  
ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

|                                     |     |      |
|-------------------------------------|-----|------|
| 1. INVESTMENT                       |     |      |
| A. CONSTRUCTION COST                | \$  | 802. |
| B. SIOH                             | \$  | 48.  |
| C. DESIGN COST                      | \$  | 44.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 805. |
| E. SALVAGE VALUE COST               | -\$ | 0.   |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 805. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 11.                   | \$ 137.                 | 11.16                 | 1529.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 0.                    | \$ 0.                   | 16.15                 | 0.                       |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 11.                   | \$ 137.                 |                       | \$ 1529.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |      |
|---|-------|------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.   |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.   |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.   |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |      |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 505. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |      |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |       |      |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |      |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |      |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 137.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 1529. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 1.90 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 5.88 |       |

**ECO-E2**

**ENERGY EFFICIENT  
LIGHTING SYSTEMS**

|                           |   |  |                          |                |
|---------------------------|---|--|--------------------------|----------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET</b><br>1        | <b>OF</b><br>1 |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b><br><br><input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                |
| <b>LOCATION</b>           | FORT LEAVENWORTH, KS                      |  |                          |                |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 |  |                          |                |
| <b>ECO MEASURE</b>        | ECO-E2                                    | <b>COMPUTED BY</b><br>DJG  | <b>CHECKED BY</b><br>MAW |                |

**AVERAGE PAYBACK TIME FOR RELAMPING AND REBALLASTING FLUORESCENT LIGHT FIXTURES**

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA

ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

ASSUME FIXTURES ARE ON FOR 365 DAYS x 12 HOURS PER DAY = 4380 HOURS PER YEAR

**2 LAMP FLUORESCENT LIGHT FIXTURE**

|   |                |
|---|----------------|
| COST TO REBALLAST LIGHT FIXTURE                               | \$58.00        |
| COST TO RELAMP LIGHT FIXTURE WITH 34W LAMPS $9.25 \times 2 =$ | \$18.50        |
| <b>TOTAL COST PER FIXTURE</b>                                 | <b>\$76.50</b> |

**ELECTRICITY SAVINGS**

|   |                            |
|---|----------------------------|
| 8W PER LAMP x 2 LAMPS PER FIXTURE   | = 16W PER FIXTURE PER HOUR |
|   | = 0.016 KWH PER FIXTURE    |
| $\$0.0425 \text{ PER KWH} \times 0.016 \text{ KWH} \times 4380 \text{ HRS}$ | = \$2.98 PER YEAR          |

**SIMPLE PAYBACK**

|                                |             |
|--------------------------------|-------------|
| TOTAL COST PER FIXTURE         | \$76.50     |
| ELECTRICITY SAVINGS PER YEAR   | \$2.98      |
| <b>SIMPLE PAYBACK IN YEARS</b> | <b>25.7</b> |

**4 LAMP FLUORESCENT LIGHT FIXTURE**

|   |                        |
|---|------------------------|
| COST TO REBALLAST LIGHT FIXTURE                               | \$58.00 x 2 = \$116.00 |
| COST TO RELAMP LIGHT FIXTURE WITH 34W LAMPS $9.25 \times 4 =$ | \$37.00                |
| <b>TOTAL COST PER FIXTURE</b>                                 | <b>\$153.00</b>        |

**ELECTRICITY SAVINGS**

|   |                            |
|---|----------------------------|
| 8W PER LAMP x 4 LAMPS PER FIXTURE   | = 32W PER FIXTURE PER HOUR |
|   | = 0.032 KWH PER FIXTURE    |
| $\$0.0425 \text{ PER KWH} \times 0.032 \text{ KWH} \times 4380 \text{ HRS}$ | = \$5.97 PER YEAR          |

**SIMPLE PAYBACK**

|                                |             |
|--------------------------------|-------------|
| TOTAL COST PER FIXTURE         | \$153.00    |
| ELECTRICITY SAVINGS PER YEAR   | \$5.97      |
| <b>SIMPLE PAYBACK IN YEARS</b> | <b>25.6</b> |

|                           |   |  |                          |                |
|---------------------------|---|--|--------------------------|----------------|
| <b>CALCULATION SHEET</b>  |   | <b>DATE</b><br>Mar-90  | <b>SHEET</b><br>1        | <b>OF</b><br>1 |
| <b>PROJECT</b>            | USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | <b>BASIS FOR CALCULATION</b>   |                          |                |
| <b>LOCATION</b>           | FORT LEAVENWORTH, KS                      | <input checked="" type="checkbox"/> <b>HAND</b><br><input type="checkbox"/> <b>COMPUTER</b><br><input type="checkbox"/> <b>CONTRACTOR BID</b><br><input type="checkbox"/> <b>OTHER (SPECIFY)</b> |                          |                |
| <b>ARCHITECT/ENGINEER</b> | CLARK RICHARDSON & BISKUP                 |  |                          |                |
| <b>ECO MEASURE</b>        | ECO-E2                                    | <b>COMPUTED BY</b><br>DJG  | <b>CHECKED BY</b><br>MAW |                |

**CALCULATIONS FOR RETROFITTING INCANDESCENT FIXTURES TO FLUORESCENT FIXTURES**  
**BUILDING 475A STAIRWELL**

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA

ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

ASSUME FIXTURES ARE ON FOR 365 DAYS x 24 HOURS PER DAY = 8760 HOURS PER YEAR

| DESCRIPTION                           | NUMBER<br>(EACH) | INSTALLED<br>COST | TOTAL<br>COST | ENERGY<br>USE (W) | TOTAL<br>ENERGY USE |
|---------------------------------------|------------------|-------------------|---------------|-------------------|---------------------|
| ADAPTER BALLAST                       | 6                | \$11.00           | \$66          | 3                 | 18                  |
| 13W DOUBLE TWIN TUBE FLUORESCENT LAMP | 6                | \$5.84            | \$35          | 13                | 78                  |
| LABOR                                 | 6                | \$3.75            | \$23          | 0                 | 0                   |
| <b>TOTAL</b>                          |                  |                   | <b>\$124</b>  |                   | <b>0.096KW</b>      |

EXISTING ELECTRICITY USAGE = 6 LAMPS x 60W PER LAMP = 360 W OR .36KW/H

NEW ELECTRICITY USAGE = 0.096 KW/H

TOTAL ELECTRICITY SAVED = 0.36 KW/H - 0.096 KW/H = 0.264 KW/H

YEARLY SAVINGS = 0.264 KW/H x \$0.0425 /KWH x 8760 HOURS/YEAR = \$98.29 PER YEAR

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 03-23-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: ECOE2  
ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

1. INVESTMENT

|                                     |     |      |
|-------------------------------------|-----|------|
| A. CONSTRUCTION COST                | \$  | 124. |
| B. SIOH                             | \$  | 7.   |
| C. DESIGN COST                      | \$  | 7.   |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 124. |
| E. SALVAGE VALUE COST               | -\$ | 0.   |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 124. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 8.                    | \$ 100.                 | 11.16                 | 1116.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 0.                    | \$ 0.                   | 16.15                 | 0.                       |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 8.                    | \$ 100.                 |                       | \$ 1116.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |      |
|---|-------|------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.   |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.   |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.   |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |      |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 368. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |      |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |       |      |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |      |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |      |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 100.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 1116. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 9.00 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 1.24 |       |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 12-5-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: GROUP #5  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

|                                     |     |        |
|-------------------------------------|-----|--------|
| 1. INVESTMENT                       |     |        |
| A. CONSTRUCTION COST                | \$  | 24206. |
| B. SIOH                             | \$  | 1452.  |
| C. DESIGN COST                      | \$  | 1331.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 24290. |
| E. SALVAGE VALUE COST               | -\$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 24290. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 17.                   | \$ 211.                 | 8.69                  | 1834.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 1699.                 | \$ 6932.                | 11.67                 | 80896.                   |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 1716.                 | \$ 7143.                |                       | \$ 82730.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |    |        |
|---|------|----|--------|
| A. ANNUAL RECURRING (+/-)                                     |      | \$ | 0.     |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |    |        |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |      | \$ | 0.     |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |      | \$ | 0.     |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |    |        |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       |      | \$ | 27301. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |    |        |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |    |        |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |    |        |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |    |        |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 7143.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 82730. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 3.41 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 3.40 |        |



## FACILITIES ENGINEERING WORK REQUEST - XFA, XFB, XFC

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

[illegible]

DESCRIPTION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

Make the following modifications to the Castle buildings:

- Add 10" of batt insulation to the attic of the rotunda.
- Install a heat recovery unit to transfer heat from exhaust air to ventilation air.
- Replace fan room doors and seal pipe penetrations in fan room walls in buildings 475C, 475D, 475F, and 475G.
- Install motion sensors for lighting control in buildings 475A, 475B, and 475H.
- Replace existing light fixtures with high efficiency units.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

Energy will continue to be wasted in building 475. Heat will be wasted through the underinsulated attic. Exhaust air will continue to waste heat to the outdoors, some of which could be used for preheat of ventilation air. Air will continue to stratify in the Castle, resulting in discomfort and wasted energy. Failure to install motion sensors will result in continued waste of lighting energy. Lighting energy will also continue to be wasted if energy efficient fixtures are not used.

| REQUESTER INFORMATION |               | PERSON TO CALL FOR ADDITIONAL INFORMATION |      | TELEPHONE N  |
|-----------------------|---------------|---|------|--------------|
| ORGANIZATION          | TELEPHONE NO. | SIGNATURE                                 | NAME | ORGANIZATION |
|                       |               |   |      |              |

| FORWARD FOR APPROVAL  |                                     |  |             | WORK TO BE PERFORMED   | FROM                |                  |
|---|-------------------------------------|--|-------------|--|---------------------|------------------|
| RECOMMENDED ACTION<br><input type="checkbox"/> APPROVAL<br><input type="checkbox"/> DISAPPROVAL | NO YES                              | ENVIRONMENTAL                              | FUNDED      | <input type="checkbox"/> IN-HOUSE<br><input type="checkbox"/> SELF-HELP<br><input type="checkbox"/> CONTRACT<br><input type="checkbox"/> TROOP | FACILITIES ENGINEER |                  |
|   | <input checked="" type="checkbox"/> | <input type="checkbox"/> CONSIDERATIONS    | WC <u>K</u> |  |                     | \$ <u>25,663</u> |
|   | <input checked="" type="checkbox"/> | <input type="checkbox"/> EIS/EIA           | WC <u>L</u> |  |                     | \$               |
|   | <input type="checkbox"/>            | INITIATED                                  | WC <u>—</u> |  |                     | \$ <u>1,166</u>  |
|   | <input checked="" type="checkbox"/> | <input type="checkbox"/> EIS/EIA COMPLETED | UNFUNDED    |  |                     |                  |
|   |                                     |  | TOTAL       | \$ <u>26,829</u>   | DATE                |                  |

| APPROVED FOR DESIGN | SOURCE OF FUNDS  |
|---------------------|--|
|                     | <input type="checkbox"/> DIRECT<br><input type="checkbox"/> AUTOMATIC REIMB.<br><input type="checkbox"/> FUNDED REIMB. |
| SIGNATURE _____     | DATE _____   |

| APPROVAL ACTION |    |        |        |      |  |    |              |           |    |    |    |
|-----------------|----|--------|--------|------|--|----|--------------|-----------|----|----|----|
| DOCUMENT NUMBER |    |        |        |      | DATE   |    | ACTION TAKEN |           |    |    |    |
| SEQ             | IO | SERIAL | NUMBER | TYPE | MO   | DA | DESIGN       | ESTIMATOR |    |    |    |
| 3               | 4  | 5      | 6      | 7    | 8  | 9  | 10           | 11        | 12 | 13 | 14 |
|                 |    |        |        |      | 15   | 16 | 17           | 18        |    |    |    |
|                 |    |        |        |      | A - APPROVED   |    |              |           |    |    |    |
|                 |    |        |        |      | O - DISAPPROVED  |    |              |           |    |    |    |
|                 |    |        |        |      | SIGNATURE OF APPROVAL AUTHORITY  |    |              |           |    |    |    |
|                 |    |        |        |      | <div style="display: flex; justify-content: space-between;"> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> <div>1</div> </div>  |    |              |           |    |    |    |
|                 |    |        |        |      | FORWARDED TO   |    |              |           |    |    |    |
|                 |    |        |        |      | <div style="display: flex; justify-content: space-between;"> <div>DESIGN</div> <div>ESTIMATOR</div> <div></div> </div> <div style="display: flex; justify-content: space-between;"> <div>MO</div> <div>DA</div> <div>DA</div> </div> <div style="display: flex; justify-content: space-between;"> <div>19</div> <div>20</div> <div>21</div> <div>22</div> <div>23</div> <div>24</div> <div>25</div> <div>26</div> </div> |    |              |           |    |    |    |

REMARKS

FORM 4283 EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED.

GROUP 5 - PAGE 21

GREEN - FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FC APPROVAL" BLOCK

## **GROUP 6**

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                              |                      | ECO    | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR  |
|--|----------------------|--------|------------------------------|-------------------------|-----------------------|--------------------------|------|
| <b>GROUP 6</b>                             |                      |        |                              |                         |                       |                          |      |
| Building 450 Repairs                       |                      |        |                              |                         |                       |                          |      |
| 450  | Solar Window Shading | ECO-A6 | 36                           | \$256                   | \$2,121               | 7.84                     | 1.66 |
| 450  | Lighting Levels      | ECO-E1 | 3                            | \$34                    | \$213                 | 5.90                     | 1.90 |
| GROUP 6 TOTALS                             |                      |        | 39                           | \$290                   | \$2,334               | 7.58                     | 1.27 |
| GROUP 6 FUNDING CATEGORY: LOW COST/NO COST |                      |        |                              |                         |                       |                          |      |

**ECO-A6**

**SOLAR WINDOW SHADING**

## ECO-A6 ECONOMIC ANALYSIS

| BUILDING<br>NUMBER | STEAM CONSUMPTION          |                            |                             | ELECTRIC CONSUMPTION |                        |                             | TOTAL<br>SAVINGS<br>(\$) |
|--------------------|----------------------------|----------------------------|-----------------------------|----------------------|------------------------|-----------------------------|--------------------------|
|                    | BASE<br>ENERGY<br>(THERMS) | ECO-A6<br>LOAD<br>(THERMS) | ENERGY<br>SAVINGS<br>(MBTU) | BASE<br>LOAD<br>(KW) | ECO-A6<br>LOAD<br>(KW) | ENERGY<br>SAVINGS<br>(MBTU) |                          |
| 450                | 3,629                      | 2,920                      | 71                          | 135,466              | 132,697                | 9                           | \$407                    |
| 463                | 1,577                      | 1,796                      | -22                         | 83,903               | 82,425                 | 5                           | (\$27)                   |
| 464                | 2,195                      | 2,352                      | -16                         | 91,802               | 90,467                 | 5                           | (\$7)                    |
| 472                | 15,515                     | 15,515                     | 0                           | 234,490              | 229,344                | 18                          | \$218                    |
| 473                | 2,407                      | 2,609                      | -20                         | 148,420              | 145,653                | 9                           | \$35                     |
| 475A               | 12,773                     | 12,773                     | 0                           | 146,357              | 136,920                | 32                          | \$401                    |
| 475B               | 8,477                      | 8,477                      | 0                           | 95,207               | 93,496                 | 6                           | \$73                     |
| 475H               | 8,137                      | 8,137                      | 0                           | 87,858               | 86,474                 | 5                           | \$59                     |
|                    |                            |                            |                             |                      |                        |                             | \$751                    |

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: 450A6  
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

|                                     |     |       |
|-------------------------------------|-----|-------|
| 1. INVESTMENT                       |     |       |
| A. CONSTRUCTION COST                | \$  | 2001. |
| B. SIOH                             | \$  | 120.  |
| C. DESIGN COST                      | \$  | 110.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 2008. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 2008. |

2. ENERGY SAVINGS (+) / COST (-)  
 ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 13.                   | \$ 162.                 | 11.16                 | 1808.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 23.                   | \$ 94.                  | 16.15                 | 1518.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 36.                   | \$ 256.                 |                       | \$ 3326.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |       |
|---|-------|-------|
| A. ANNUAL RECURRING (+/-)                                     | \$    | 0.    |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |       |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$    | 0.    |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$    | 0.    |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |       |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$    | 1098. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |       |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |       |       |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |       |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |       |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 256.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 3326. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 1.66 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 7.84 |       |

ENG. FORM 150  
1AVC-59

**ECO-E1**

**LIGHTING LEVELS**



|   |  |  |                   |
|---|--|--|-------------------|
| <b>CALCULATION SHEET</b>                          |  | DATE<br>Mar-90   | SHEET 1 OF 1      |
| PROJECT USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  | BASIS FOR CALCULATION<br><br>X HAND<br>COMPUTER<br>CONTRACTOR BID<br>OTHER (SPECIFY) |                   |
| LOCATION FORT LEAVENWORTH, KS                     |  |  |                   |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP   |  |  |                   |
| ECO MEASURE<br>ECO-E1                             |  | COMPUTED BY<br>DJG   | CHECKED BY<br>MAW |

BASED ON THE FOLLOWING INFORMATION:  
 \$200.62 FOR TYPICAL MOTION SENSOR INSTALLATION  
 \$0.0425 PER KWH ELECTRICITY COST  
 11.16 25-YEAR DISCOUNT FACTOR

| BUILDING #<br>AND ROOM TYPE | LIGHTING<br>WATTS | ANNUAL<br>NORMAL<br>HOURS | ANNUAL<br>HOURS<br>SAVED | ANNUAL<br>KWH<br>SAVED | ANNUAL<br>SAVINGS | PAYBACK<br>IN YEARS | SIR |
|-----------------------------|-------------------|---------------------------|--------------------------|------------------------|-------------------|---------------------|-----|
| 450<br>CONFERENCE ROOM      | 1280              | 2080                      | 624                      | 799                    | \$33.96           | 5.9                 | 1.9 |
| 475A<br>CONFERENCE ROOM     | 640               | 2080                      | 624                      | 399                    | \$16.96           | 11.8                | 0.9 |
| 475A<br>CHAPEL              | 1620              | 2080                      | 624                      | 1011                   | \$42.97           | 4.7                 | 2.4 |
| 475E<br>CONFERENCE ROOM     | 480               | 2080                      | 624                      | 300                    | \$12.75           | 15.7                | 0.7 |
| 475B<br>CHAPEL              | 1500              | 2080                      | 624                      | 936                    | \$39.78           | 5.0                 | 2.2 |
| 475H<br>CHAPEL              | 800               | 2080                      | 624                      | 499                    | \$21.21           | 9.5                 | 1.2 |
| TOTAL<br>(SIR >1)           | 5200              | 2080                      | 624                      | 3245                   | \$137.91          | 8.7                 | 1.3 |

|  |  |                   |                 |
|--|--|-------------------|-----------------|
| <b>CALCULATION SHEET</b>                             |  | DATE<br>Oct-90    | SHEET OF<br>1 1 |
| PROJECT<br>USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY | BASIS FOR CALCULATION<br><br>X HAND<br>COMPUTER<br>CONTRACTOR BID<br>OTHER (SPECIFY) |                   |                 |
| LOCATION<br>FORT LEAVENWORTH, KS                     |  |                   |                 |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP      |  |                   |                 |
| ECO MEASURE<br>ECO-E1                                | COMPUTED BY<br>DJG   | CHECKED BY<br>MAW |                 |

AVERAGE PAYBACK TIME FOR REPLACING EXISTING SWITCHES  
WITH INFRARED MOTION SENSORS FOR VARIOUS SPACES

ALL COSTS ARE BASED ON MEANS CONSTRUCTION/DEMOLITION COST DATA  
ELECTRICITY COST FOR FORT LEAVENWORTH USDB IS \$0.0425 PER KWH

MOTION SENSOR INSTALLATION COST

|                             |          |
|-----------------------------|----------|
| DEMO EXISTING SWITCH BOX    | \$2.66   |
| DEMO 8' EMT WITH WIRING     | \$5.76   |
| INSTALL 20', 3/4" EMT       | \$53.60  |
| INSTALL 40', #12 CONDUCTORS | \$13.60  |
| INSTALL MOTION SENSOR       | \$125.00 |
| TOTAL COST PER INSTALLATION | \$200.62 |

POSSIBLE ENERGY SAVINGS FOR TYPICAL CONFERENCE ROOM

|  |            |
|--|------------|
| LIGHTING LOAD                                | 720 WATTS  |
| ANNUAL LIGHTING TIME                         | 2080 HOURS |
| ANNUAL COST @ \$0.0425 PER KWH               | \$63.65    |
| ANNUAL SAVINGS IF LIGHTS ARE OFF 30% OF TIME | \$19.10    |
| COST OF INSTALLATION                         | \$200.62   |
| PAYBACK TIME                                 | 10.5 YEARS |

POSSIBLE ENERGY SAVINGS FOR TYPICAL SMALL OFFICE ROOM

|  |            |
|--|------------|
| LIGHTING LOAD                                | 320 WATTS  |
| ANNUAL LIGHTING TIME                         | 2080 HOURS |
| ANNUAL COST @ \$0.0425 PER KWH               | \$28.29    |
| ANNUAL SAVINGS IF LIGHTS ARE OFF 25% OF TIME | \$7.07     |
| COST OF INSTALLATION                         | \$200.62   |
| PAYBACK TIME                                 | 28.4 YEARS |

NOTE: SAVINGS ARE VERY DEPENDENT ON SEVERAL ITEMS, WHICH INCLUDE THE FOLLOWING:  
1) CURRENT PRACTICES IN SWITCHING LIGHTS OFF. IF PEOPLE NORMALLY TURN LIGHTS OFF WHEN NOT IN USE, ENERGY SAVINGS WILL BE MINIMAL.  
2) AMOUNT OF TIME THAT LIGHTS WILL NOT BE IN USE. THE ABOVE ESTIMATES MAY VARY AND ACTUAL SAVINGS WILL FLUCTUATE ACCORDINGLY.

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 03-30-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: ECOE1  
 ECONOMIC LIFE 25 YEARS

PREPARED BY: CRB

|                                     |     |      |
|-------------------------------------|-----|------|
| 1. INVESTMENT                       |     |      |
| A. CONSTRUCTION COST                | \$  | 802. |
| B. SIOH                             | \$  | 48.  |
| C. DESIGN COST                      | \$  | 44.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 805. |
| E. SALVAGE VALUE COST               | -\$ | 0.   |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 805. |

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 11.                   | \$ 137.                 | 11.16                 | 1529.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 0.                    | \$ 0.                   | 16.15                 | 0.                       |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 11.                   | \$ 137.                 |                       | \$ 1529.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |       |    |      |
|---|-------|----|------|
| A. ANNUAL RECURRING (+/-)                                     |       | \$ | 0.   |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 11.65 |    |      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |       | \$ | 0.   |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |       | \$ | 0.   |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |       |    |      |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       |       | \$ | 505. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |       |    |      |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |       |    |      |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |       |    |      |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |       |    |      |

|  |                 |       |
|--|-----------------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$              | 137.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$              | 1529. |
| 6. DISCOUNTED SAVINGS RATIO (IF < 1 PROJECT DOES NOT QUALIFY)    | (SIR)=(5 / 1F)= | 1.90  |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    |                 | 5.88  |

LIFE CYCLE COST ANALYSIS SUMMARY  
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
PROJECT NO. & TITLE: 1496  
FISCAL YEAR 1990  
ANALYSIS DATE: 12-5-90

STUDY: USDBAE  
LCCID 1.035  
CENSUS: 2

DISCRETE PORTION NAME: GROUP #6  
ECONOMIC LIFE 15 YEARS  
PREPARED BY: CRB

|                                     |     |       |
|-------------------------------------|-----|-------|
| 1. INVESTMENT                       |     |       |
| A. CONSTRUCTION COST                | \$  | 2214. |
| B. SIOH                             | \$  | 133.  |
| C. DESIGN COST                      | \$  | 122.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$  | 2222. |
| E. SALVAGE VALUE COST               | -\$ | 0.    |
| F. TOTAL INVESTMENT (1D-1E)         | \$  | 2222. |

2. ENERGY SAVINGS (+) / COST (-)  
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 16.                   | \$ 199.                 | 8.69                  | 1729.                    |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 12.42                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 12.21                 | 0.                       |
| D. NAT G | \$ 4.08                 | 23.                   | \$ 94.                  | 11.67                 | 1097.                    |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 10.36                 | 0.                       |
| F. TOTAL |                         | 39.                   | \$ 293.                 |                       | \$ 2826.                 |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |      |      |
|---|------|------|
| A. ANNUAL RECURRING (+/-)                                     | \$   | 0.   |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11 |      |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         | \$   | 0.   |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) | \$   | 0.   |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |      |      |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$   | 933. |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |      |      |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |      |      |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |      |      |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |      |      |

|  |      |       |
|--|------|-------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 293.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 2826. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 1.27 |       |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |       |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 7.58 |       |

# FACILITIES ENGINEERING WORK REQUEST - XFA, XFB, XFC

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent agency is the Office of the Chief of Engineers.

| TRANS CODE | REQ ID | DOCUMENT NUMBER |        | BUILDING/FACILITY |    | DATE |    | OTHER FUND CITATION |        | SHORT JOB DESCRIPTION |        | BUILDING/FACILITY |        | BLANK |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------------|--------|-----------------|--------|-------------------|----|------|----|---------------------|--------|-----------------------|--------|-------------------|--------|-------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|            |        | SERIAL NUMBER   | NUMBER | SUFFIX            | YR | MO   | DA | NUMBER              | SUFFIX | NUMBER                | SUFFIX | NUMBER            | SUFFIX |       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 2          | 3      | 4               | 5      | 6                 | 7  | 8    | 9  | 10                  | 11     | 12                    | 13     | 14                | 15     | 16    | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| 2          | 3      | 4               | 5      | 6                 | 7  | 8    | 9  | 10                  | 11     | 12                    | 13     | 14                | 15     | 16    | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |

DESCRIPTION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

Add solar shading film to the south, east and west windows in building 450. This will reduce the solar heat gain, resulting in cooling energy savings. Install motion sensors in building 450. This will save energy by turning lights off during unoccupied times.

If the windows remain untinted, spaces in building 450 will continue to experience large solar loads in the cooling season. Failure to install motion sensors could result in continued waste of lighting energy because of lights being left on during unoccupied times.

| REQUESTER INFORMATION |              | PERSON TO CALL FOR ADDITIONAL INFORMATION |              |
|-----------------------|--------------|---|--------------|
| NAME                  | ORGANIZATION | NAME                                      | ORGANIZATION |
|                       |              |   |              |

| FORWARD FOR APPROVAL  |  | APPROVED FOR DESIGN  |  | SOURCE OF FUNDS |      |
|---|--|--|--|-----------------|------|
| RECOMMENDED ACTION  | ENVIRONMENTAL IMPACT   | ESTIMATED COST   | WORK TO BE PERFORMED   | SIGNATURE       | DATE |
| <input type="checkbox"/> APPROVAL<br><input type="checkbox"/> DISAPPROVAL | NO YES<br><input checked="" type="checkbox"/> ENVIRONMENTAL CONSIDERATIONS<br><input checked="" type="checkbox"/> EIS/EIA INITIATED<br><input checked="" type="checkbox"/> EIS/EIA COMPLETED | FUNDED \$ 2,334<br>WC X<br>UNFUNDED \$ 106<br>TOTAL \$ 2,440 | <input type="checkbox"/> IN-HOUSE<br><input type="checkbox"/> SELF-HELP<br><input type="checkbox"/> CONTRACT<br><input type="checkbox"/> TROOP |                 |      |

| PROVIDING AUTHORITY |      | FACILITIES ENGINEER |      |
|---------------------|------|---------------------|------|
| NAME                | DATE | NAME                | DATE |
|                     |      |                     |      |

| APPROVAL ACTION |                                 | FORWARDED TO |           |
|-----------------|---------------------------------|--------------|-----------|
| DATE            | ACTION TAKEN                    | DESIGN       | ESTIMATOR |
| 15/16/17/18     | A - APPROVED<br>O - DISAPPROVED | MO DA        | MO DA     |

| SIGNATURE OF APPROVAL AUTHORITY |      |
|---------------------------------|------|
| SIGNATURE                       | DATE |
|                                 |      |

| REMARKS |  |
|---------|--|
|         |  |

| GREEN   |  |
|---|--|
| PROJECT FILE COPY   |  |
| FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FC APPROVAL" BLOCK |  |

| PINK  |  |
|---|--|
| WHITE (ORIGINAL) - PROJECT FILE COPY                                |  |
| FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FC APPROVAL" BLOCK |  |

| GROUP 6 - PAGE 9                                  |  |
|---|--|
| EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED. |  |

| FORM 1 AUG 78 |  |
|---------------|--|
| 4283          |  |

## **GROUP 7**

**ENERGY CONSERVATION ANALYSIS  
ESOS**

| PROJECT GROUP                             | ECO    | ENERGY<br>SAVINGS<br>MBTU/YR | ENERGY<br>SAVINGS<br>\$ | PROJECT<br>COST<br>\$ | SIMPLE<br>PAYBACK<br>YRS | SIR  |
|---|--------|------------------------------|-------------------------|-----------------------|--------------------------|------|
| <b>GROUP 7</b><br>Energy Efficient Motors |        |                              |                         |                       |                          |      |
| All Buildings in the USDB                 | ECO-E3 | 248                          | \$3,085                 | \$22,185              | 6.81                     | 1.64 |
| GROUP 7 TOTALS                            |        | 248                          | \$3,085                 | \$22,185              | 6.81                     | 1.64 |
| GROUP 7 FUNDING CATEGORY: NONE            |        |                              |                         |                       |                          |      |

**ECO-E3**

**ENERGY EFFICIENT MOTORS**



**AVERAGE EFFICIENCIES AND ENERGY SAVINGS FOR  
VARIOUS MOTOR SIZES  
STANDARD VS HIGH EFFICIENCY  
PAYBACKS FOR REPLACING AN EXISTING MOTOR**

| HORSE-POWER | STANDARD MOTOR EFFICIENCY | HI EFF MOTOR EFFICIENCY | STANDARD MOTOR WATT LOSS | HI EFF MOTOR WATT LOSS | WATT LOSS DIFFERENCE | INSTALLED HI EFF MTR COST |
|-------------|---------------------------|-------------------------|--------------------------|------------------------|----------------------|---------------------------|
| 1           | 76.5                      | 84.0                    | 229                      | 142                    | 87                   | \$420                     |
| 1.5         | 78.5                      | 85.5                    | 306                      | 190                    | 117                  | \$442                     |
| 2           | 80.8                      | 86.5                    | 355                      | 233                    | 122                  | \$466                     |
| 3           | 79.9                      | 88.5                    | 563                      | 291                    | 272                  | \$582                     |
| 5           | 83.1                      | 89.5                    | 759                      | 438                    | 321                  | \$644                     |
| 7.5         | 83.8                      | 90.2                    | 1082                     | 608                    | 474                  | \$820                     |
| 10          | 85.0                      | 90.2                    | 1316                     | 811                    | 506                  | \$966                     |
| 15          | 86.5                      | 91.7                    | 1746                     | 1013                   | 734                  | \$1,255                   |
| 20          | 87.5                      | 93.0                    | 2131                     | 1123                   | 1008                 | \$1,527                   |
| 25          | 88.0                      | 93.0                    | 2543                     | 1404                   | 1139                 | \$1,780                   |
| 30          | 88.1                      | 93.0                    | 3023                     | 1685                   | 1338                 | \$2,030                   |
| 40          | 89.4                      | 93.6                    | 3538                     | 2040                   | 1498                 | \$2,623                   |
| 50          | 90.4                      | 94.1                    | 3961                     | 2339                   | 1622                 | \$3,232                   |

| HORSE-POWER | 8760 HOURS     |              |                |     | 5000 HOURS     |              |                |     |
|-------------|----------------|--------------|----------------|-----|----------------|--------------|----------------|-----|
|             | ENERGY SAVINGS | COST SAVINGS | SIMPLE PAYBACK | SIR | ENERGY SAVINGS | COST SAVINGS | SIMPLE PAYBACK | SIR |
| 1           | 763            | \$32         | 13.0           | 0.9 | 435            | \$19         | 22.7           | 0.5 |
| 1.5         | 1,022          | \$43         | 10.2           | 1.1 | 584            | \$25         | 17.8           | 0.6 |
| 2           | 1,066          | \$45         | 10.3           | 1.1 | 608            | \$26         | 18.0           | 0.6 |
| 3           | 2,384          | \$101        | 5.7            | 1.9 | 1,361          | \$58         | 10.1           | 1.1 |
| 5           | 2,812          | \$119        | 5.4            | 2.0 | 1,605          | \$68         | 9.4            | 1.2 |
| 7.5         | 4,150          | \$176        | 4.6            | 2.4 | 2,369          | \$101        | 8.1            | 1.4 |
| 10          | 4,432          | \$188        | 5.1            | 2.2 | 2,530          | \$108        | 9.0            | 1.2 |
| 15          | 6,426          | \$273        | 4.6            | 2.4 | 3,668          | \$156        | 8.1            | 1.4 |
| 20          | 8,834          | \$375        | 4.1            | 2.7 | 5,042          | \$214        | 7.1            | 1.5 |
| 25          | 9,981          | \$424        | 4.2            | 2.6 | 5,697          | \$242        | 7.4            | 1.5 |
| 30          | 11,725         | \$498        | 4.1            | 2.7 | 6,692          | \$284        | 7.1            | 1.5 |
| 40          | 13,120         | \$558        | 4.7            | 2.3 | 7,489          | \$318        | 8.2            | 1.3 |
| 50          | 14,212         | \$604        | 5.4            | 2.1 | 8,112          | \$345        | 9.4            | 1.2 |

| HORSE-POWER | 4380 HOURS     |              |                |     | 2920 HOURS     |              |                |     |
|-------------|----------------|--------------|----------------|-----|----------------|--------------|----------------|-----|
|             | ENERGY SAVINGS | COST SAVINGS | SIMPLE PAYBACK | SIR | ENERGY SAVINGS | COST SAVINGS | SIMPLE PAYBACK | SIR |
| 1           | 381            | \$16         | 25.9           | 0.4 | 254            | \$11         | 38.9           | 0.3 |
| 1.5         | 511            | \$22         | 20.3           | 0.5 | 341            | \$14         | 30.5           | 0.4 |
| 2           | 533            | \$23         | 20.6           | 0.5 | 355            | \$15         | 30.9           | 0.4 |
| 3           | 1,192          | \$51         | 11.5           | 1.0 | 795            | \$34         | 17.2           | 0.6 |
| 5           | 1,406          | \$60         | 10.8           | 1.0 | 937            | \$40         | 16.2           | 0.7 |
| 7.5         | 2,075          | \$88         | 9.3            | 1.2 | 1,383          | \$59         | 13.9           | 0.8 |
| 10          | 2,216          | \$94         | 10.3           | 1.1 | 1,477          | \$63         | 15.4           | 0.7 |
| 15          | 3,213          | \$137        | 9.2            | 1.2 | 2,142          | \$91         | 13.8           | 0.8 |
| 20          | 4,417          | \$188        | 8.1            | 1.4 | 2,945          | \$125        | 12.2           | 0.9 |
| 25          | 4,991          | \$212        | 8.4            | 1.3 | 3,327          | \$141        | 12.6           | 0.9 |
| 30          | 5,862          | \$249        | 8.1            | 1.4 | 3,908          | \$166        | 12.2           | 0.9 |
| 40          | 6,560          | \$279        | 9.4            | 1.2 | 4,373          | \$186        | 14.1           | 0.8 |
| 50          | 7,106          | \$302        | 10.7           | 1.0 | 4,737          | \$201        | 16.1           | 0.7 |

25 YEAR DISCOUNT FACTOR = 11.16

ELECTRICITY COST = 4.25¢/KWH

| CALCULATION SHEET                                 |     |                         |                               | DATE<br>Mar-90   |                   | SHEET OF<br>1 2   |                  |
|---|-----|-------------------------|-------------------------------|--|-------------------|-------------------|------------------|
| PROJECT USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |     |                         |                               | BASIS FOR CALCULATION<br><br>X HAND<br>COMPUTER<br>CONTRACTOR BID<br>OTHER (SPECIFY) |                   |                   |                  |
| LOCATION FORT LEAVENWORTH, KS                     |     |                         |                               |  |                   |                   |                  |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP   |     |                         |                               |  |                   |                   |                  |
| ECO MEASURE<br>ECO-E3                             |     |                         |                               | COMPUTED BY<br>DJG   |                   | CHECKED BY<br>MAW |                  |
| BUILDING # AND<br>MOTOR DESCRIPTION               | HP  | OPER.<br>HOURS/<br>YEAR | SAVINGS<br>PER YEAR<br>MBTU'S | SAVINGS<br>PER YEAR<br>DOLLARS   | INSTALLED<br>COST | SIR               | PAYBACK<br>YEARS |
| BUILDING 463<br>FAN                               | 1.5 | 4380                    | 1.7                           | \$21.15  | \$442             | 0.5               | 20.9             |
| BUILDING 463<br>CONDENSING UNIT                   | 5   | 4380                    | 4.8                           | \$59.71  | \$644             | 1.0               | 10.8             |
| BUILDING 464<br>FAN                               | 1.5 | 4380                    | 1.7                           | \$21.15  | \$442             | 0.5               | 20.9             |
| BUILDING 464<br>FAN                               | 1.5 | 4380                    | 1.7                           | \$21.15  | \$442             | 0.5               | 20.9             |
| BUILDING 465<br>COMPRESSOR                        | 5   | 5000                    | 5.5                           | \$68.42  | \$644             | 1.2               | 9.4              |
| BUILDING 465<br>COMPRESSOR                        | 5   | 5000                    | 5.5                           | \$68.42  | \$644             | 1.2               | 9.4              |
| BUILDING 465<br>COLD WATER PUMP                   | 1.5 | 4380                    | 1.7                           | \$21.15  | \$442             | 0.5               | 20.9             |
| BUILDING 465<br>HOT WATER PUMP                    | 7.5 | 4380                    | 7.1                           | \$88.32  | \$820             | 1.2               | 9.3              |
| BUILDING 465<br>AIR HANDLING UNIT                 | 2   | 4380                    | 1.8                           | \$22.39  | \$466             | 0.5               | 20.8             |
| BUILDING 465<br>AIR HANDLING UNIT                 | 1   | 4380                    | 1.3                           | \$16.17  | \$420             | 0.4               | 26.0             |
| BUILDING 465<br>AIR HANDLING UNIT                 | 1   | 4380                    | 1.3                           | \$16.17  | \$420             | 0.4               | 26.0             |
| BUILDING 472<br>HOT WATER PUMP                    | 3   | 4380                    | 4.1                           | \$51.00  | \$582             | 1.0               | 11.4             |
| BUILDING 472<br>FAN                               | 1.5 | 4380                    | 1.7                           | \$21.15  | \$442             | 0.5               | 20.9             |
| BUILDING 473<br>HOT WATER PUMP                    | 3   | 4380                    | 4.1                           | \$51.00  | \$582             | 1.0               | 11.4             |
| BUILDING 473<br>HOT WATER PUMP                    | 5   | 4380                    | 4.8                           | \$59.71  | \$644             | 1.0               | 10.8             |
| BUILDING 474<br>BOILER FEED PUMP                  | 40  | 8760                    | 44.8                          | \$557.31   | \$2,623           | 2.4               | 4.7              |
| BUILDING 474<br>FAN                               | 10  | 8760                    | 15.1                          | \$187.84   | \$966             | 2.2               | 5.1              |
| BUILDING 474<br>FAN                               | 10  | 8760                    | 15.1                          | \$187.84   | \$966             | 2.2               | 5.1              |
| BUILDING 474<br>FAN                               | 10  | 8760                    | 15.1                          | \$187.84   | \$966             | 2.2               | 5.1              |
| BUILDING 474<br>CONDENSATE PUMP                   | 10  | 8760                    | 15.1                          | \$187.84   | \$966             | 2.2               | 5.1              |
| BUILDING 474<br>CONDENSATE PUMP                   | 10  | 8760                    | 15.1                          | \$187.84   | \$966             | 2.2               | 5.1              |
| BUILDING 474<br>AIR COMPRESSOR                    | 3   | 8760                    | 8.1                           | \$100.76   | \$582             | 1.9               | 5.8              |
| BUILDING 474<br>AIR COMPRESSOR                    | 25  | 8760                    | 34.1                          | \$424.20   | \$1,780           | 2.7               | 4.2              |
| 25-YEAR DISCOUNT FACTOR= 11.16                    |     |                         |                               |  |                   |                   |                  |

|   |  |  |  |  |   |  |                   |  |
|---|--|--|--|--|---|--|-------------------|--|
| <b>CALCULATION SHEET</b>                          |  |  |  |  | DATE<br>Mar-90 -  |  | SHEET OF<br>2 - 2 |  |
| PROJECT USDB<br>ENERGY SAVINGS OPPORTUNITY SURVEY |  |  |  |  | BASIS FOR CALCULATION<br><br><input checked="" type="checkbox"/> HAND<br><input type="checkbox"/> COMPUTER<br><input type="checkbox"/> CONTRACTOR BID<br><input type="checkbox"/> OTHER (SPECIFY) |  |                   |  |
| LOCATION FORT LEAVENWORTH, KS                     |  |  |  |  |   |  |                   |  |
| ARCHITECT/ENGINEER<br>CLARK RICHARDSON & BISKUP   |  |  |  |  |   |  |                   |  |
| ECO MEASURE<br>ECO-E3                             |  |  |  |  | COMPUTED BY<br>DJG  |  | CHECKED BY<br>MAW |  |

| BUILDING # AND<br>MOTOR DESCRIPTION     | HP  | OPER.<br>HOURS/<br>YEAR | SAVINGS<br>PER YEAR<br>MBTU'S | SAVINGS<br>PER YEAR<br>DOLLARS | INSTALLED<br>COST | SIR | PAYBACK<br>YEARS |
|---|-----|-------------------------|-------------------------------|--------------------------------|-------------------|-----|------------------|
| BUILDING 475<br>ROTUNDA CONDENSING UNIT | 3   | 4380                    | 4.1                           | \$51.00                        | \$582             | 1.0 | 11.4             |
| BUILDING 475<br>ROTUNDA CONDENSING UNIT | 7.5 | 4380                    | 7.1                           | \$88.32                        | \$820             | 1.2 | 9.3              |
| BUILDING 475C<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475C<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475D<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475D<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475F<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475F<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475G<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| BUILDING 475G<br>FAN                    | 5   | 4380                    | 4.8                           | \$59.71                        | \$644             | 1.0 | 10.8             |
| TOTAL<br>(SIR > 1)                      |     |                         | 248                           | \$3,085.00                     | \$20,929          | 1.6 | 6.8              |

25-YEAR DISCOUNT FACTOR= 11.16

LIFE CYCLE COST ANALYSIS SUMMARY  
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)  
 INSTALLATION & LOCATION: FORT LEAVENWORTH - USDB REGION NOS. 7  
 PROJECT NO. & TITLE: 1496  
 FISCAL YEAR 1990  
 ANALYSIS DATE: 03-19-90

STUDY: USDBAE  
 LCCID 1.035  
 CENSUS: 2

DISCRETE PORTION NAME: GROUP #7  
 ECONOMIC LIFE 15 YEARS  
 PREPARED BY: CRB

|                                     |    |        |
|-------------------------------------|----|--------|
| 1. INVESTMENT                       |    |        |
| A. CONSTRUCTION COST                | \$ | 20929. |
| B. SIOH                             | \$ | 1256.  |
| C. DESIGN COST                      | \$ | 1151.  |
| D. ENERGY CREDIT CALC (1A+1B+1C)X.9 | \$ | 21002. |
| E. SALVAGE VALUE COST               | \$ | 0.     |
| F. TOTAL INVESTMENT (1D-1E)         | \$ | 21002. |

2. ENERGY SAVINGS (+) / COST (-)  
 ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

| FUEL     | UNIT COST<br>\$/MBTU(1) | SAVINGS<br>MBTU/YR(2) | ANNUAL \$<br>SAVINGS(3) | DISCOUNT<br>FACTOR(4) | DISCOUNTED<br>SAVINGS(5) |
|----------|-------------------------|-----------------------|-------------------------|-----------------------|--------------------------|
| A. ELECT | \$ 12.44                | 248.                  | \$ 3085.                | 11.16                 | 34429.                   |
| B. DIST  | \$ .00                  | 0.                    | \$ 0.                   | 17.19                 | 0.                       |
| C. RESID | \$ .00                  | 0.                    | \$ 0.                   | 17.12                 | 0.                       |
| D. NAT G | \$ 4.08                 | 0.                    | \$ 0.                   | 16.15                 | 0.                       |
| E. COAL  | \$ .00                  | 0.                    | \$ 0.                   | 13.92                 | 0.                       |
| F. TOTAL |                         | 248.                  | \$ 3085.                |                       | \$ 34429.                |

3. NON ENERGY SAVINGS(+) / COST(-)

|   |           |    |    |
|---|-----------|----|----|
| A. ANNUAL RECURRING (+/-)                                     |           | \$ | 0. |
| (1) DISCOUNT FACTOR (TABLE A)                                 | 9.11      |    |    |
| (2) DISCOUNTED SAVING/COST (3A X 3A1)                         |           | \$ | 0. |
| C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3Bd4) |           | \$ | 0. |
| D. PROJECT NON ENERGY QUALIFICATION TEST                      |           |    |    |
| (1) 25% MAX NON ENERGY CALC (2F5 X .33)                       | \$ 11362. |    |    |
| A IF 3D1 IS = OR > 3C GO TO ITEM 4                            |           |    |    |
| B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=                     |           |    |    |
| C IF 3D1B IS = > 1 GO TO ITEM 4                               |           |    |    |
| D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY                     |           |    |    |

|  |      |        |
|--|------|--------|
| 4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) | \$   | 3085.  |
| 5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)                         | \$   | 34429. |
| 6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=                      | 1.64 |        |
| (IF < 1 PROJECT DOES NOT QUALIFY)                                |      |        |
| 7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4                    | 6.81 |        |

Energy will continue to be wasted by operation of standard efficiency motors.

Replace existing standard efficiency motors with high efficiency motors, where economically feasible. Use energy efficient motors when replacing motors during regular maintenance. This will result in higher complex power factors at the USDB and less electrical energy consumption.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

REASON AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

|                       |      |   |           |
|-----------------------|------|---|-----------|
| REQUESTER INFORMATION |      | PERSON TO CALL FOR ADDITIONAL INFORMATION |           |
| ORGANIZATION          | NAME | ORGANIZATION                              | TELEPHONE |

|   |   |  |  |                 |      |
|---|---|--|--|-----------------|------|
| FORWARD FOR APPROVAL  |   | APPROVED FOR DESIGN  |  | SOURCE OF FUNDS |      |
| RECOMMENDED ACTION  | ENVIRONMENTAL IMPACT  | ESTIMATED COST   | WORK TO BE PERFORMED   | DATE            | DATE |
| <input type="checkbox"/> APPROVAL<br><input type="checkbox"/> DISAPPROVAL | <input checked="" type="checkbox"/> NO YES<br><input type="checkbox"/> ENVIRONMENTAL CONSIDERATIONS<br><input type="checkbox"/> EIS/EIA INITIATED<br><input type="checkbox"/> EIS/EIA COMPLETED | FUNDED<br>WC X \$ 22,185<br>WC L \$<br>WC UNFUNDED \$ 1,008<br>TOTAL \$ 23,193 | <input type="checkbox"/> IN-HOUSE<br><input type="checkbox"/> SELF-HELP<br><input type="checkbox"/> CONTRACT<br><input type="checkbox"/> TROOP | SIGNATURE       | DATE |
| NG AUTHORITY  |   | FACILITIES ENGINEER  |  | DATE            |      |

|                                 |              |                                    |           |
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| APPROVAL ACTION                 |              | FORWARDED TO                       |           |
| DATE                            | ACTION TAKEN | DESIGN                             | ESTIMATOR |
| MO                              | DA           | MO                                 | DA        |
| 15                              | 15           | 19                                 | 23        |
| 17                              | 17           | 23                                 | 23        |
| 18                              | 18           | 25                                 | 25        |
| SIGNATURE OF APPROVAL AUTHORITY |              | SIGNATURE OF APPROVAL ACTION BLOCK |           |

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